

CHAPTER 18

A NEW APPROACH TO NUCLEAR POWER

On the last day of March 1958 Lewis Strauss wrote the President to acknowledge that his reappointment as chairman was not politically feasible. "Just as a ship too long at sea collects barnacles," Strauss noted, so had he "acquired the hostility of a small but vocal coterie of columnists" and of Senator Anderson. He offered to continue to serve as an adviser to the President, but for the good of the Administration he had decided not to seek reappointment as a Commissioner.¹ Although Eisenhower for the moment refused to accept Strauss's decision as final, the White House staff, with Strauss's assistance, began to search for a replacement.

ENTER MCCONE

From the beginning of the search John A. McCone was a leading candidate. A Californian, McCone began his business career as a construction engineer for the Llewellyn Iron Works in 1922. When the Bechtel-McCone Corporation was organized in 1937, McCone became president and director. During World War II he was executive vice-president of the Consolidated Steel Corporation and president of the California Shipbuilding Corporation. As president of the Joshua Hendy Corporation after the war, he operated a fleet of merchant ships that transported chemicals, petroleum products, and ores. In addition to his business and financial activities, McCone served as special deputy to Secretary of Defense James Forrestal during 1948 and in 1950 became Under Secretary of the Air Force in charge of procurement. Early in 1954 Dulles appointed him to the State Department's public committee on personnel. McCone's technical background,

his solid record as a conservative Republican businessman, and his government experience attracted Strauss's attention in 1957, when he was seeking a replacement for Murray. McCone in fact was offered Murray's seat; but he declined, as he explained forthrightly, because he would accept nothing less than the chairmanship.²

A year later that obstacle was removed by Strauss's decision to leave the Commission, and McCone readily accepted the appointment. Strauss had not been mistaken in his appraisal of McCone's political and economic outlook. As a self-made man, McCone had proved to himself that it was possible to do things in private enterprise without government assistance. McCone, however, was not doctrinaire on the subject. As one of his former assistants explained to a reporter, McCone was, if anything, more conservative than Strauss, but he was an "open-minded conservative." He preferred to let private business do the job, but, if government could do it better, McCone was not opposed to government programs. McCone's principal asset was "his razor-sharp intelligence that can pierce any proposal, reduce it to a skeleton of basics."³

McCone's other assets were his friendship with Eisenhower and the President's confidence in him. Unlike Strauss, a Taft supporter barely known to Eisenhower in 1952, McCone had worked with Eisenhower since 1947, first as a member of the Air Policy Commission and then as Under Secretary of the Air Force. Subsequently McCone had visited Eisenhower at Columbia University. With Strauss's departure, McCone had little interest in becoming Eisenhower's next special adviser on nuclear energy; rather he wanted to sit as a member of the National Security Council and the Cabinet. In this regard, with McCone the chairmanship of the Commission had reached its apogee.

Strauss's contention that most of the Commission's troubles with the Joint Committee stemmed from Senator Anderson's "almost psychopathic dislike for me" seemed to have some basis in fact when Anderson announced in mid-June that he was willing "to let the dead past bury its dead and go on to happier days." Despite Robert Zehring's fears that Anderson would hold the McCone nomination hostage in the committee's struggle with the Commission over the power reactor program, Anderson called the confirmation hearing on July 2 and completed the questioning in two hours. Anderson and Holifield asked McCone for his opinions on nuclear weapon testing, safeguards, and the development of nuclear power but did not press him beyond his straightforward but tentative replies. Some echoes from the Strauss period were heard when Anderson raised the question of McCone's conception of the role of the chairman in relation to the Commission and the White House and asked McCone about his understanding of the statutory requirement to keep the Joint Committee "fully and currently informed." McCone parried these thrusts without giving either ground or offense.⁴

McCone was fully sensitive to the need to improve the Commission's relationship with the Joint Committee and especially with Anderson, the touchy and hard-driving senator who would likely resume the committee chairmanship in 1959. McCone had no intention of letting slide the issues that Anderson had raised at the confirmation hearing; he was simply looking for a better forum for discussion. On July 16, two days before he was sworn in as chairman, McCone called on Anderson to see what could be done to clear the air. Anderson said he was confident that frank discussions of issues would avoid the kinds of problems that had damaged relations in the past. Without appearing overly conciliatory, McCone accepted the senator's premise; his demeanor suggested that he would not hesitate to state his views clearly and directly. That was a stance Anderson could understand.⁵

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THE FIRST TEST

McCone had an opportunity to use his forthright approach a few weeks later when he met privately with Holifield and then with Anderson to discuss Congressional action on the proposed EURATOM agreement and the authorization bill. On June 25, as Strauss was clearing out his office at the Commission's headquarters, the Joint Committee had reported out the authorization bill, precisely doubling the \$194 million that the Administration had requested for power-reactor development. The total in the bill was close to the \$400 million originally proposed by the committee in its private discussions with the Commissioners. The bill designated \$145 million for a new plutonium production reactor, which both the Commission and the White House had opposed; \$68 million for the design of four additional power reactors; and \$37.9 million for basic research facilities. On August 4, when Eisenhower signed the authorization bill, he criticized the committee's action and urged "the Congress to guard more vigilantly against the ever present tendency to burden the government with programs, . . . the relative urgency and essentiality of which have not been solidly determined."⁶

Holifield interpreted the President's language as meaning that the committee had been irresponsible. The President had also implied that he might hold back from the Commission the funds authorized for not only the plutonium reactor but also the gas-cooled reactor, which had been included in the Administration's bill, on the grounds that the legislation had imposed an unrealistic time limit on the submission of private proposals. McCone reassured Holifield that the Commission had every intention to proceed on the gas-cooled reactor "energetically and . . . exactly in accordance with the legislation." On the plutonium reactor, however, McCone said frankly that the economics of the design, particularly its dual-purpose feature, were

unacceptable to him, and he expected to make an independent study of the issues. Holifield seemed willing to await the results of that review.

McCone found Anderson equally resentful of the President's attack on the authorization bill, but the senator insisted that his opposition to the EURATOM agreement was substantive and not capricious. As he had stated during the public hearings in June, most of his objections to the proposed agreement related to financial issues rather than safeguards, but in the privacy of his office he could be more specific about his objections. He told McCone that he was concerned that the Commission had never even discussed the Export-Import Bank's loan, necessary to finance the construction of American reactors abroad. He questioned the feasibility of the plan for returning spent fuel elements to the United States for reprocessing. He did not like the provision of \$50 million for research and development of reactor designs by the EURATOM countries; but most of all, Anderson objected to a \$90-million item in the EURATOM authorization bill to cover cost overruns that might be incurred by American manufacturers in fulfilling performance guarantees on fuel assemblies for EURATOM reactors. Anderson claimed that the real purpose of the provision was to bail out Westinghouse, which at Strauss's insistence had given an Italian utility a very attractive guarantee for the SENN reactor. McCone listened patiently to Anderson's objections but made no promises.⁷

When the EURATOM package came before the Joint Committee on July 22, McCone assigned Commissioner Floberg and Deputy General Manager Richard W. Cook to present the Administration's case. The details of the bilateral agreement, the memorandum of understanding, and the assorted working papers were too intricate for McCone to master during the first weeks of his chairmanship. Fortunately Floberg was well versed on the subject and made impressive use of his considerable debating skills as a lawyer in explaining the text of the agreements during four days of grueling testimony.

Anderson's private discussion with McCone proved an accurate indicator of the course the hearings would take. In negotiating the EURATOM agreement during spring 1958, the Commission had been preoccupied with the safeguards issue, particularly as it related to the International Atomic Energy Agency. Girded for battle on this subject, C. Douglas Dillon, the Under Secretary of State for economic affairs, was relieved to discover on the first day of the hearings that the Joint Committee had few questions about safeguards. Instead, the hearings followed Anderson's interest and concentrated on the dollar figures in the EURATOM authorization bill and on fine points of reciprocity in the agreement documents. In the end, Floberg's persistence and debating skill paid off. The committee with some grumbling accepted the agreements, trimmed back but did not delete the funds provided for research and development, and placed tighter restrictions on the use of funds for fuel guarantees.⁸

FIRST IMPRESSIONS

Within the Commission McCone, perhaps to his satisfaction, discovered that he would have to chart his own course on a nuclear power policy. Both Kenneth E. Fields, the general manager, and Cook had resigned when Strauss's term ended; Cook stayed on only until the EURATOM hearings were completed. W. Kenneth Davis, the director of reactor development, had already announced his decision to leave during the summer as had his principal assistants in the division. Strauss had already selected Alvin R. Luedecke, an Air Force general, to be general manager, but Luedecke would not report to the Commission until after he had completed his assignment as commander of Joint Task Force Seven, which was conducting the *Hardtack* series of weapon tests in the Pacific. In the meantime Paul F. Foster, a former Navy admiral, engineer, and Chicago department store executive, would serve as acting general manager. In 1954 Strauss had brought Foster from the World Bank to the Commission, where he had served as a special assistant to the general manager for international affairs in 1956. Dependable, wise, and judicious in temperament, Foster at age sixty-nine was an ideal choice for this interim assignment.⁹ Although Foster had been active on the staff for three years, he had no special knowledge of reactor development.

With Davis on his way out of the government, McCone relied on Rickover to give him his first inside glimpse of the Commission's reactor program. On a three-day trip with Rickover to Knolls, Bettis, Shippingport, and the Idaho test station, McCone had enough engineering experience to engage in technical discussions, and he quickly proved that he could identify the critical points of disagreement in a technical argument.

At Knolls, McCone was struck by the statement of one General Electric official that the company's commercial division did not give serious enough attention to designing reactor cores. This opinion led McCone to pursue the question of whether large equipment manufacturers like General Electric and Westinghouse accepted lower design standards on their commercial work than on the naval projects. At Bettis, McCone found that Westinghouse engineers denied any shortcuts in design that would produce a dependable power reactor. Yet McCone was surprised that the Westinghouse commercial division expected to produce power reactors at one-fourth or one-fifth the cost of Shippingport.

After visiting Shippingport and being greatly impressed by "its design, lay-out, safety and beautiful condition," McCone fully understood that the installation was not really a power plant but "a laboratory tool." In that sense it was unfair to dismiss Shippingport, as some industry leaders were doing, as irrelevant because its capital costs were so high. When McCone, however, excluded the expensive test equipment and heavy redundancy in design at Shippingport, he was still not satisfied. He noted

that both Bettis and Knolls were concentrating on the problem of core design and that both laboratories expected vast improvement in core performance and a substantial reduction in costs within a few years. This McCone could understand because he realized that both the physics and engineering of core design were in a very early stage of development.¹⁰

What impressed McCone even more, however, was the fact that both companies were proceeding at once to install in commercial reactors fuel assemblies using cheaper and possibly less dependable materials than Rickover had specified in the Navy projects. McCone noted that the Yankee Atomic plant, which Westinghouse had designed, would use slightly enriched uranium-oxide pellets, which would be sealed in stainless steel rods. At first glance it seemed logical that these fuel assemblies for Yankee would be much less expensive than the fully enriched uranium, clad in zirconium, which the Navy was using. Rickover had already raised questions about the integrity and reliability of the commercial cores. McCone appreciated this concern, but he even had questions about the savings in cost. He suspected that the commercial divisions of the companies were overlooking the fact that the amount of energy used in enriching uranium (and hence the cost) was not proportional to the level of enrichment. Thus, enriching uranium to 3 percent content of uranium-235 took on the order of 50 percent, not 3 percent, of the energy needed for full enrichment.¹¹

McCone found Westinghouse engineers vague on the amount of uranium or the level of enrichment they expected to use in their commercial plants. He was also suspicious of the statement that the value of the spent fuel elements would be so low that recovery of the uranium would not be worthwhile. McCone concluded that if the uranium was not recovered, actual fuel costs for the reactors would be very high, and he realized that this cost would be borne by the government under the power demonstration program. "There seemed to be an attitude," McCone wrote in his notes, "on the part of the commercial people at both Westinghouse and indirectly General Electric to ride on the fact that there was no fuel cost involved." For instance, it was obvious that the Westinghouse people were going to design the Yankee plant to produce the cheapest power, irrespective of the amount of uranium used, "because they do not pay for the uranium. . . . I am sure that General Electric is doing the same thing."

On the integrity and dependability of fuel elements McCone noted sharp differences in design philosophy between Rickover's group and the manufacturers. To achieve long core life, the Navy insisted on high integrity in every fuel element on the grounds that a slight break in one element would bring water in contact with the uranium and cause a swelling that would result in a chain reaction of damage. This reasoning explained the extreme care used in fabricating and inspecting fuel elements for the Navy projects. In contrast, McCone found that the commercial manufacturers took this matter "rather lightly." He noted that Westinghouse intended to

place uranium in commercially manufactured tubes without knowing exactly how this was to be done. Although the Yankee plant was already under construction, there seemed to be no plans to inspect the tubes for imperfections or to determine what the results might be if a tube failed.

In his personal notes on the trip McCone wrote:

As a result of these discussions, I am convinced that our reactor division must make the most penetrating study of how the commercial people intend to answer their core design and construction problems. It seems to me that it will be the center of our problem both from the standpoint of economics and ultimate success and safety.

One receives the impression in travelling that so many companies have launched forward blindly into this field making huge investments in engineering organizations and plants and equipment that they now are rather desperately advancing exotic and extreme and sometimes unsound developments in the hope of gaining contracts against which to advertise their facility investment and to employ their organization.

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McCone reminded himself that he would not proceed with "anything which is unsound," but he did intend to take a constructive approach to nuclear power.

COOPERATING WITH THE JOINT COMMITTEE

McCone's open-minded approach to technical issues also carried over to political matters, particularly the Commission's relationships with the Joint Committee. The new chairman was not plagued by Strauss's nagging suspicion that every proposal by the committee's Democratic majority was motivated by a desire to socialize the electric power industry. Thus, McCone was not alarmed when he learned that James T. Ramey, the committee's executive director, had assembled a panel of reactor and utility experts to draft a long-term nuclear power policy. The panel, which included Walter Zinn and Henry Smyth, consisted of men who were above question in both knowledge and integrity. Working through the spring and into the summer of 1958, the panel hammered out four drafts of the policy statement before releasing it for public comment in August.¹²

In most respects the panel's draft contained few surprises for the Commission staff or the nuclear industry. Based solidly on the consensus reached by the Commission and the committee during their off-the-record discussions earlier in the year, the panel stated the objectives of its plan: "to demonstrate economically competitive nuclear power in the United States by 1970 and in 'high cost' free world nations by 1968." These dates reflected some relaxation of the ten- and five-year goals discussed by both

groups in February, but the intention was the same. The goals were expected to "fortify" the nation's position of worldwide leadership in the peaceful applications of atomic energy, particularly in developing nuclear power. In other words, the panel recognized no immediate need for nuclear power in the United States to justify the proposal. Ultimately, however, nuclear power would be required at home as reserves of cheap conventional fuels were exhausted, particularly if the national demand for electricity continued to double every ten years.

The plan of action proposed by the panel also followed conventional wisdom. Through its research contractors and the national laboratories the Commission would continue to provide the general research and development needed to support engineering design and construction. As in the past the Commission would also be responsible for initial feasibility studies, reactor experiments, and prototype construction. Private industry would continue to participate by undertaking research and development for specific projects and by building full-scale nuclear power plants.

The panel, however, sharply rejected Strauss's policy of leaving to industry decisions about the course and speed of development. Going back to the American Assembly report and the industry seminars in autumn 1957, the panel echoed the need for "positive direction" by the Commission. The panel intended that the Commission should no longer permit the national laboratories and contractors to decide which types of reactors they would study but rather that it should establish a comprehensive plan for each reactor type. "Positive direction" also included the selection of reactors to be built under the power demonstration program and the setting of realistic dates for submission, approval, and negotiation of proposals for each project. And contrary to the Commission's practice during the Strauss era, the Commission "promptly would assume responsibility for construction" if industry did not respond with proposals for private construction in a reasonable length of time.

Getting down to specifics, the panel envisaged the construction of twenty-one reactors of diversified types over the next five to seven years. These included nine large, four intermediate, and three small power reactors, in addition to five reactor experiments by the Commission. Only about half of these were expected to prove worthy of full-scale construction. A rough estimate of the total cost of development and construction was \$875 million.

One encouraging aspect of the Joint Committee's action was that there was no attempt to ram the program through Congress and down the Administration's throat. Rather Ramey sent copies of the plan to a large number of equipment manufacturers and electric utilities along with a questionnaire that encouraged frank views on every aspect of the plan. The questionnaires, dispatched on August 25, 1958, were to be returned by November 1 so that they could be tabulated and discussed at a seminar

sponsored by the Joint Committee well in advance of the first session of the new Congress.¹³

McCone, who received the report a few days earlier, promptly sent it to the staff for careful appraisal. Before leaving for the peaceful uses conference in Geneva, McCone sent three copies to Rickover with a request that the admiral and his staff give them serious attention. McCone also informed Rickover that he had asked Foster to appoint an ad hoc committee to study the Joint Committee proposal and requested Rickover and his senior advisers to take time from "your important work" to discuss the plan with the advisory committee. In McCone's mind a key issue was one Rickover had discussed in a meeting with the Commissioners on the evening of September 17: Did industry's efforts to achieve economic nuclear power for central-station use constitute a threat to public safety? Rickover suspected strongly that it might, and McCone acknowledged that opinion. But he also reminded Rickover that there was "a division of thought" within both the Commission and industry on the question, and it was helpful to discuss the issues.¹⁴

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A NEW ADMINISTRATIVE STYLE

McCone's willingness to open policy issues for discussion revealed an administrative style sharply contrasting with Strauss's way. Strauss had seen issues largely in political terms; McCone viewed them in terms of technical and economic realities. Strauss dealt in personalities and liked to speculate on hidden motives; McCone was more interested in facts than opinions. Strauss took into his confidence only those whom he trusted and tried to exclude the influence of others; McCone sought ideas from many sources in the belief that he could select the best course of action from the diversity of opinion. In this sense McCone seemed more self-confident than had Strauss in his ability to make decisions. Once McCone had weighed the evidence, he was comfortable about his decisions and moved on to other things; Strauss, however, preferred to maneuver others into supporting his position without fully declaring himself, and he tended to brood over the motives of those whom he failed to win to his side.

Never one to spend much time discussing organization or management procedures, McCone quickly revealed by his actions a new approach to administering the Commission's reactor development program. While Strauss had relied on Kenneth Davis to translate administrative policy into specific programs, McCone chose to use the new ad hoc advisory committee established by Foster for this purpose. He made it clear that he expected the committee to do more than window-dressing. The membership list, which McCone approved personally, contained the names of eight highly regarded business executives, scientists, and engineers, including Henry

Smyth, former General Manager Marion W. Boyer, Harvey Brooks of Harvard, and Eger V. Murphree, an Esso engineer who had been serving on atomic energy advisory groups since 1941.¹⁵

As for Davis's replacement, McCone accepted Foster's recommendation of Frank K. Pittman, who had served as acting director for several months after Davis and his senior associates had departed. Unlike Davis, who looked upon federal service as a temporary tour of duty, Pittman was a career civil servant. Although just forty-four years old, Pittman had behind him fourteen years of government management experience, nine of them in the Commission's Washington headquarters. A chemical engineer who had studied and taught at the Massachusetts Institute of Technology, Pittman had served as deputy to Harold L. Price in setting up the Commission's regulatory program. In fall 1957, as an outgrowth of the industry seminars on nuclear power, the Commission had set up an independent division of industrial development with Pittman in charge. From that position he had moved into reactor development after Davis's departure.

In both positions Pittman reported to Alphonso Tammaro, former engineering officer in the Manhattan Project who was now assistant general manager for research and industrial development. Although volatile and often outspoken, Tammaro knew the atomic energy establishment like the back of his hand; he had a reputation for being both responsible and responsive to the Commissioners. Tammaro gave Pittman his chance to demonstrate his abilities as acting successor to Davis and saw that he received the permanent appointment in October 1958. By that time Pittman was fully in control of the job. Although he had little background in reactor technology, Pittman, like Tammaro, knew how the agency worked. He went about his job quietly and efficiently and tried as much as possible to stay out of the way of McCone, whom he considered a bloodless taskmaster. Despite being uncomfortable with McCone, Pittman fit perfectly into the new chairman's mode of operation. He was unemotional and objective in his approach to problems, disinterested in but not insensitive to political issues, adept in finding practical solutions, and perfectly willing to leave the headaches of policy making to McCone and the ad hoc committee.¹⁶

GETTING THE FACTS

While Tammaro and the advisory committee members immersed themselves in the policy issues that would arise in drafting any national plan for nuclear power, Pittman and his division set about assembling the technical data that would form the basis for the plan. First to receive attention were the engineering studies for the heavy-water-moderated power reactor, two large-scale power reactors, and one intermediate-size prototype reactor mandated by the Joint Committee in the authorization act of August 4,

1958. To meet this requirement the Commission invited qualified companies to submit proposals for engineering studies and cost estimates for a boiling-water, a pressurized-water, and an organic-cooled reactor. Proposals were to be submitted by architect-engineering firms working with nuclear reactor manufacturers no later than October 15, 1958, so that initial results of the studies could be sent to the Joint Committee by May 1, 1959, as required by the Congress.¹⁷

The division issued similar invitations for proposals to study fuel-cycle problems and to provide space in test reactors for irradiating experimental fuel elements and materials. General studies of the fuel cycle received a \$10-million allocation, including research on the properties of fuels and other materials, the design of fuel elements, new fabrication techniques, and testing. An additional \$8.5 million in 1959 was earmarked for research relating to specific applications in power reactors being developed in cooperation with industry.

Responses to the invitations were excellent. On the reactor studies the Commission received 86 proposals from 32 architect-engineering firms, and from these it was possible to select 3 experienced and well-qualified contractors. For the fuel-cycle work, the Commission received 107 proposals from 39 companies. Before the end of 1958, 4 companies had indicated an interest in providing irradiation space in test reactors.¹⁸

Although McCone's open approach to nuclear power issues and the additional funding provided by the supplemental budget encouraged the use of outside contractors, Pittman did not rely on them exclusively. He wanted, in fact, to build a much stronger technical staff at headquarters than Davis had used. When severe limitations on personnel were imposed by the Bureau of the Budget, Pittman adopted the practice of creating task forces on specific technical problems. The task forces usually consisted of one or two members of the division's headquarters staff with five or six experts from the national laboratories or industry. By using task forces Pittman was able in autumn 1958 to undertake a systematic review of all the division's activities without substantially increasing the size of his organization. Again this device provided for an open investigation of technical issues from various perspectives.

The work of Pittman's task forces complemented the deliberations of the ad hoc committee, which began a series of two-day meetings in early October. Because the committee had been charged with developing both a policy statement and the specific programs to support it, the members had to delve deeply into the technology of all reactor types under consideration. Foster had charged the committee to begin its policy deliberations by considering the long-range plan that his predecessor had negotiated with Ramsey during spring 1958 as well as the draft plan released by the Joint Committee panel in August. Because Smyth had been the principal architect of the Joint Committee's proposal and was now serving as the effective

chairman of the Commission's advisory committee, there was little question that the new plan would reflect its forerunners. The favorable industry response to the Joint Committee's questionnaire gave the ad hoc committee added justification for drawing on the ideas of its predecessors.¹⁹

When the ad hoc committee reported in January 1959, it endorsed the common objectives of the two previous studies: the United States should "fortify" its position of leadership in nuclear power technology; and it should attempt to make nuclear power economically competitive in some areas of the United States within ten years and somewhat earlier abroad. To these aims the committee added two new ones: the first, to continue studies of reactor systems that offered possibilities of much greater cost reductions within twenty or thirty years but not within a decade; the second, to make the fullest possible use of uranium and thorium reserves by incorporating good neutron economy in reactor designs but more especially by developing the breeder reactor. Achieving these goals would require a broad program of applied research, not just on specific types of reactors but also on generic problems such as improvements in both the fuel cycle and the fabrication of fuel elements.

The committee also stressed the need for design decisions and the construction of many prototypes based on a wide variety of designs. In fact, the list of reactor types endorsed by the committee appeared to include every concept that the Commission had been considering over the past five years. In this respect the committee's proposal was more ambitious than the Joint Committee's, but, by concentrating on reactor experiments and prototypes with a generating capacity of no more than eighty electrical megawatts, the committee believed it would be possible to fund a research and development effort of unprecedented scope and magnitude at an annual cost of \$200 million to \$225 million, about \$50 million below the Joint Committee's price tag.

The report seemed to attempt to build on the earlier Commission and Joint Committee proposals and to go somewhat beyond them but not so far as to make the new plan unacceptable. The advisers urged both the Commission and the Joint Committee to agree on a formal statement of objectives that would "explain the necessity for leadership by the Federal Government, in cooperation with industry" because "cooperation between the two groups is the most important single factor in the success of this country's nuclear power program."²⁰

POLITICAL REALITIES

In some respects the recommendations of the ad hoc committee supported McCone's strategies for developing nuclear power. Smyth and his col-

leagues acknowledged McCone's conclusion that the introduction of nuclear power would be more difficult and costly than many people had expected. The report also exposed the shallow reasoning of those who had urged the United States to join the "kilowatt race" by accelerating the construction of full-scale nuclear power plants. If big plants were not yet feasible as monuments to the nation's technological superiority, the pressures on the Commission's budget could be eased to that extent. Furthermore, the high quality of the report and its even-handed, if not unbiased, tone suggested that McCone had been correct in believing that it was possible to evaluate technical issues without becoming mired down in the personal and ideological disputes that had plagued the Strauss era.

McCone knew, however, by the time the ad hoc committee's report was completed that he could not escape the political realities of the enduring conflict between the Democratic-controlled Joint Committee and the Republican Administration. On December 29, 1958, Pittman told the Commissioners that shifting research and development from specific projects to a more general program of applied research would increase operating expenditures in 1960 by \$15 million. The construction of prototypes recommended by the committee would increase construction requirements in 1960 by \$45 million and mean an increase in the authorization request of \$150 million. Cooperative programs with industry would require an additional \$20 million. The chances seemed extremely remote that the Administration would authorize increases of this magnitude.

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Since September the Commission had been in a running battle with the Bureau of the Budget in an effort to obtain adequate funding for fiscal 1960. In November the bureau had cut the Commission's budget request by \$563 million in obligational authority, about \$300 million below the 1959 level. Although most dollars would come from projects other than nuclear power development, the cuts did include elimination of funds for the gas-cooled reactor and one cooperative project, while all other reactor development expenditures were retained at existing levels. When the Commission appealed this decision, the Bureau of the Budget insisted on cuts of more than \$250 million in nondefense programs. To meet this demand, the Commission had to find ways to trim an additional \$60 million from the reactor development budget; this meant a reduction in some applied research areas where the ad hoc committee had recommended increases.²¹

Early in January 1959 McCone faced the unwelcome task of presenting these unpleasant facts to the Joint Committee at the annual Section 202 and authorization hearings. Pittman began work at once on a new statement of the Commission's reactor program that would save as much as possible of the ad hoc committee's recommendations. The statement went through several drafts during late January and early February. Trying to accommodate both the Administration and the Joint Committee was a pain-

ful process, but McCone had both the new program and a draft authorization bill in hand when he went to the Hill on February 17 to testify at the opening of the Section 202 hearings.²²

It was no surprise to the Joint Committee that the Commission accepted the five objectives proposed by the ad hoc advisory group. After all, as Senator Gore and Congressman Holifield observed, objectives were easy to state; fulfillment was more difficult. Overlooking these barbs, McCone pressed on to assert his strong personal agreement with the ad hoc group's contention that power reactor development should concentrate on prototypes rather than full-scale plants. He also conceded that the Commission would have to take responsibility for deciding which reactor types were ready for the prototype stage. The Commission would invite both public and private utilities to submit proposals similar to those required in the power demonstration program but with one new feature: the Commission was now proposing to offer grants for capital costs. This new proposal was not lost on the Joint Committee, which had consistently opposed capital grants since 1954.²³

When McCone's presentation turned to specific projects, it was apparent that the Commission had decided to make the best case that it could to adopt the broad approach to nuclear power recommended by the ad hoc group rather than to focus on only the most attractive designs. Thus, the 1959 program sounded much like those Strauss had presented in the past. In each of six reactor categories, McCone could list several projects—either reactor experiments funded by the Commission or cooperative projects with industry. As Senator Gore remarked, the statement sounded as if the Commission had left “no stone unturned.” Yet, the senator said, it seemed to be the same proposal submitted in 1956 with two changes: adding capital grants and eliminating any deadline for submission of industry proposals. Even worse, Gore argued, the Commission had dropped five of the eight prototypes and all three reactor experiments proposed a year earlier. In some instances new projects had been substituted for those canceled, but Gore contended that the new authorization bill actually provided only \$14.5 million for Commission reactor programs, compared to \$74.5 million approved by Congress the year before. McCone could challenge Gore's arithmetic, but he could not refute the senator's premise that the Administration was cutting back the reactor program. Only a week earlier, in a private conversation with McCone, the President had made it clear that he wanted to keep the government from “getting deeper into this matter.”²⁴

While McCone was trying to make the best of a difficult situation, Holifield began to zero in on specific reactor items in the Commission's draft of the authorization bill even though the hearings on the bill would not start for another ten days. When an aide handed McCone a press release just issued by Holifield, the chairman exploded in angry accusation that the congressman was attacking the Commission's proposals before he

had even completed his testimony. By the time McCone first appeared at the authorization hearings on February 27, however, both men went out of their way to admit a misunderstanding and to deny that the dispute had been personal. The incident impressed upon Holifield and his colleagues that McCone indeed was more interested in issues than in personalities, but at the same time the new chairman would not tolerate politically motivated abuse.²⁵

MOVING TOWARD A PROGRAM

The altercation with Holifield seemed to clear the air for productive discussions between McCone and the Joint Committee. In four additional extended appearances before the committee over the next ten weeks McCone patiently but firmly responded to every query and suggestion. Gradually the barbed questions and nasty implications that had peppered the committee's hearings during the Strauss era disappeared, and it was possible for McCone and his staff to discuss rather than debate items in the appropriation bill. McCone gave the impression that he was doing the best he could to accelerate power reactor development within the tight financial limits imposed by the Bureau of the Budget and the President. After all, these limits constituted a reality that the Congress as well as McCone had to face. Furthermore, the appropriation bill that McCone presented was far from a niggardly concession to the committee's demands but rather a positive and thoughtful proposal. In the bill the Commission proposed to start or expand five power reactor experiments at the Idaho test site, support five military reactor projects, and fund the construction of two experimental power reactors by the Commission and two prototypes to be built under cooperative agreements with either public or private utilities, a provision that effectively defused the old private-versus-public power fight.

McCone was careful in his presentation to explain the distinction he was making between experimental plants and prototypes, both in terms of size and function. He was forthright in stating that the Commission had an important role in building experimental reactors and in determining what kinds of prototypes were needed and when. After the Commission completed conceptual designs and general specifications for the prototypes, utilities would be invited to submit proposals for design, construction, and operation of the plants. The prototypes were not to be considered entries in a "kilowatt race" but rather sources of reliable data on construction costs and "statistically significant information on efficiency, performance characteristics, and other operating factors in a manner which will permit reliable projection toward central station powerplants." In short, McCone was seeking the kind of solid data that engineers and businessmen needed to make sound decisions about nuclear power.²⁶

McCone's decision to focus reactor development on prototypes rather than full-scale power plants had several advantages. In addition to producing reliable data, prototypes could be constructed at less expense and greater speed than full-size plants. Thus, they made optimum use of the limited funding available and made it possible for the Administration to support more projects without breaking the budget. As long as the additional projects were well-conceived and well-executed, they also blunted the committee's interest in the "Gore-Holifield" approach, which seemed fiscally irresponsible to both the Administration and many Democrats. In fact, Senator Anderson and many of his committee colleagues liked to think of themselves as conservative on budget matters. By the time the hearings concluded on May 8, 1959, Anderson had gained so much confidence in McCone that he suggested that the Joint Committee could relax some of the cost controls included in previous authorization acts because "the Chairman of the Atomic Energy Commission is a very shrewd businessman and will watch it [the budget] carefully."²⁷

Between his appearances before the Joint Committee McCone demonstrated that he was serious about evaluating the Commission's development projects and applying resources where they would do the most good. He did not exclude reassessments of projects for which contracts had already been let. When evaluation showed that two power demonstration projects for sodium-cooled reactors were not moving in a promising direction technically, McCone asked Pittman to explore with the contractors the possibility of terminating the work. In the first instance, the contractor agreed to cancel design work for one of these reactors, to be built at Chugach, Alaska. When Pittman discovered that cancelling the second sodium-cooled plant, at Hallam, Nebraska, would in the long run cost the government more than continuing it, McCone took the pragmatic course of extending the project even though recent experimental evidence indicated that the Hallam project would not produce engineering data of exceptional value. In both instances McCone was able to reach decisions without incurring outbursts of criticism from the contractors, the Joint Committee, or the nuclear industry.²⁸

On the politically sensitive question of gas-cooled reactors, McCone proceeded cautiously but without equivocation. For more than two years the Joint Committee had been prodding the Commission to develop a gas-cooled power reactor, mainly in response to the British decision to commit its entire domestic and foreign nuclear power effort to that type of plant. Under committee pressure the Commission had agreed in 1958 to start design studies for a gas-cooled, graphite-moderated reactor and awarded a contract to Kaiser Engineers and American Car and Foundry Company (ACF) for that purpose. When the Joint Committee inserted a provision in the 1959 authorization act requiring the Commission itself to begin constructing the reactor if a satisfactory industry proposal were not received

within ninety days after the bill became law, the Administration had denounced this requirement as a deliberate effort to force the Commission to build a full-scale plant. The Bureau of the Budget had approved only \$30 million for the project rather than the \$51 million authorized by the committee, a reduction that would make it possible to build only an experimental or prototype reactor.²⁹

The Administration's decision had been based almost entirely on its desire to keep the government out of power plant construction and to balance the budget. McCone, however, was able to avoid another political fight with the Joint Committee by analyzing the Kaiser-ACF proposal and concluding that it did not warrant construction on technical grounds. Instead, McCone proposed to build a flexible prototype within the \$30-million limit and to proceed with negotiations with the Philadelphia Electric Company, representing fifty-two utility companies, to build a high-temperature, helium-cooled prototype designed by the General Dynamics Corporation. Again for technical reasons McCone was not enthusiastic about the General Dynamics design because it represented a bold extrapolation of existing technology, but he was willing to commit some government funding if a reasonable compromise could be reached with the Joint Committee on authorization. As the committee was learning, McCone's idea of a reasonable compromise was to take only a calculated technical risk of failure after the proposal had been carefully analyzed for economic and engineering perspectives and to commit no more money than seemed necessary. Rather than confrontation, the McCone approach fostered discussion and joint decision.³⁰

McCone was equally harsh in evaluating existing work on fluid-fuel reactors, which included the homogeneous and molten-salt reactors at Oak Ridge and the experiment with liquid-metal fuels at Brookhaven. Because Pittman's task force found that none of these experimental plants would contribute to the Commission's nuclear power objectives established early in 1958, all three projects were phased out in spring 1959, to be replaced by a long-range research effort to develop a breeder reactor using slow neutrons. On Pittman's recommendation and under McCone's leadership the Commission decided to focus its resources on water- and organic-cooled reactors, which still showed the greatest promise of producing economical nuclear power within the next decade. This decision was based in part on the results of the four reactor studies mandated by the Congress in the 1959 authorization act and completed in May 1959.³¹

McCone, Pittman, and the staff discussed all these and other studies at length with the Joint Committee during the course of the authorization hearings. As the weeks slipped by, Anderson, Holifield, and their colleagues came to appreciate the new spirit and attitude that McCone brought to decisions. Although the committee members did not always agree with the Commission's conclusions, they were persuaded that McCone and his

associates were making an honest effort to get the facts and that they were acting in good faith. Thus, for the first time since the authorization procedure had been enacted in 1954, the committee's final recommendations represented a broad basis of agreement on the issues and a true compromise of remaining points of difference. The nine power reactor experiments and prototypes authorized for 1960 were more than the Commission had initially requested but less than the committee had sought. McCone could accept the outcome as consistent with the state of the technology and reasonable within the Administration's budget limitations. The chairman's only significant defeat was his failure to obtain approval of construction grants for prototypes, but he had the satisfaction of knowing that Senator Anderson shared his disappointment.³²

THE SAVANNAH CRISIS

One application of nuclear power that McCone could not afford to overlook was ship propulsion. In 1955 Eisenhower had personally conceived the idea of building a nuclear-powered "peace ship" that could tour the world with exhibits that would dramatize the peaceful uses of atomic energy. The President hoped that, by using a carbon copy of the *Nautilus* reactor and a cargo hull of standard design, it would be possible to have the "peace ship" in operation in a year or less. When both the Commission and the Joint Committee privately doubted the project's feasibility as the President had proposed it, Eisenhower's project was quietly scuttled after the Congress failed to authorize it in summer 1955. Eisenhower, however, had no intention of abandoning the idea, and in 1956 he directed the Commission and the U.S. Maritime Administration jointly to develop plans for the ship.³³

Studies by the two agencies during 1957 resulted in a plan significantly different from the President's original conception. Instead of a "peace ship," which many members of Congress had criticized as little more than a publicity stunt, the two agencies now proposed to build a dry-cargo merchant ship, which would demonstrate the feasibility of using nuclear propulsion for commercial vessels. The second departure from the original plan was to use a nuclear propulsion plant designed specifically for the purpose by a private contractor rather than a copy of the *Nautilus* reactor. Rickover himself maintained that the *Nautilus* plant was not suitable, and the Commission staff estimated that a private contractor could provide a new reactor at about one-third the cost of the Navy plant. No doubt with Strauss's encouragement, the Babcock & Wilcox Company accepted a contract to design and build the reactor and the propulsion equipment while the New York Shipbuilding Corporation agreed to construct the ship. Both contractors started work in 1958, and on July 21, 1959, Mrs. Eisenhower attended the launching and christened the new vessel,

the *Savannah*, after the first steam-powered transatlantic ship to be built in the United States.³⁴

By the time McCone became chairman in summer 1958 the *Savannah* project was in high gear under the direction of Richard P. Godwin and the maritime reactors branch in the division of reactor development. As the new director of the division, Pittman probably knew little more about the project in autumn 1958 than McCone did, but it was only a matter of time before McCone's systematic evaluation of every Commission project would focus on the *Savannah*. Once he turned his attention to the project, it did not take McCone long to discover some troubling facts. First, there was far from a unanimous opinion among the Commission staff and contractor officials that all the design features of the propulsion plant were safe and reliable. Second, both Godwin and the contractors admitted that no one had clear responsibility for coordinating the installation of the nuclear propulsion plant in the hull and conducting plant tests and sea trials. Third, it was also evident that inadequate plans had been made for training the ship's officers and crew, particularly in reactor operation and maintenance.³⁵

Serious as these differences were, McCone was even more concerned about the fact that the contractor had designed the nuclear propulsion plant without consulting Rickover, his staff, or the naval reactor laboratories. It was true that Babcock & Wilcox had been fabricating components for nuclear submarines for at least five years and had hired well-qualified reactor engineers to design the reactor plant, but McCone found it incredible that the contractor would deliberately ignore the mass of experience and knowledge that the Navy project had generated since 1946. After expressing his concerns to Rickover, McCone informed General Manager Luedecke that the naval reactors branch would survey the *Savannah* project and report its findings to the Commission. The chairman also suggested that the Commission's senior staff was not sufficiently supervising the project.³⁶

When news of the survey leaked out, the press interpreted it as a power play by Rickover to take over the *Savannah* project. The facts could hardly be more contrary to that rumor. As a matter of principle, Rickover never wanted to bear any responsibility for a project over which he did not have complete control. He also must have realized that, with all the major decisions already made, it would be hard to offer positive criticism and thereby avoid appearing to confirm the press stories. When Rickover found it impossible to refuse McCone's request, he agreed to do the survey; but he stood firm that he would merely report the facts and make no recommendations. McCone accepted this condition and made clear to the staff and the press that there was no thought of transferring supervision of the *Savannah* project to Rickover. Obviously trying to minimize the role of his staff in the review, Rickover restricted his investigation to examining design documents and safety studies, and he completed the entire survey in one

week. His report did not produce any new or startling information about the *Savannah* reactor. Rather, members of Rickover's staff explained ways in which a number of features in the ship's reactor differed from long-established design principles in the Navy project, and they suggested how these specifics might complicate operation and maintenance of the ship reactor. Godwin then addressed each of these points, mainly by elaborating upon the fundamental differences between the operational requirements for the merchant ship propulsion plant and naval propulsion plants. McCone's probing and Rickover's survey did not result in major redesign of the *Savannah* plant, but they did help to resolve issues over crew training and the division of contractor responsibility. Most important, Luedecke, Tammaro, Pittman, and Godwin, as well as the contractors, were now well aware that McCone had the facts and would hold these officials responsible for effective project management.³⁷

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THE LONG-RANGE PLAN

McCone's down-to-earth review of the Commission's nuclear power plans with the Joint Committee during spring 1959 moved slowly in the direction of consensus. But McCone knew that the decisions incorporated in the authorization act of 1960 represented nothing more than a stopgap. The successful development of nuclear power required something more than piecemeal measures taken in the course of the annual authorization process. Three days after his final appearance at the authorization hearings in May 1959 McCone asked Luedecke to set up a special group to draft a long-range plan for further development of the reactor types most likely to meet the Commission's ten-year objective for economical nuclear power. Always with an eye on the practical, McCone wanted the staff to concentrate on prototypes for large central-station power plants and to evaluate each reactor type in terms of its current technical status and economic promise.³⁸

It was also clear that McCone took seriously his commitment to the Joint Committee to complete the plan before the end of 1959. Within two weeks after receiving McCone's directive, Luedecke, Tammaro, and Pittman agreed on the scope and outline of the study, and Pittman's staff recruited contractor personnel to prepare the first two reports, which, in accordance with the McCone style, summarized the technical and economic status of each reactor type. By the time these reports were completed on June 30, Luedecke and Pittman had arranged for the Atomic Industrial Forum to organize a task force of engineers well known in the industry to establish the criteria for evaluating the reactor types.

A working subcommittee representing the organization of each principal was established to do the evaluations. Throughout summer 1959 the

subcommittee worked closely with Pittman's staff and national laboratory engineers to assure that the evaluation criteria were sensible and uniform for all the reactor types under study. Criteria were carefully defined and, whenever possible, expressed quantitatively so that the evaluation would not unintentionally skew the result. When the nine evaluations were completed, Pittman discussed them with industry representatives and with the ad hoc advisory committee on reactor policies and programs, which had been reconvened for this purpose. The evaluations, together with recommendations for the future, constituted Part 4 of the long-range plan.³⁹

The draft that Pittman submitted to the Commission on December 17, 1959, clearly reflected McCone's approach to technical management. The plan was direct, to the point, frank in its evaluations, quantitative where possible, and specific in its recommendations. It did not represent a radical or dramatic departure from the past but rather an extension and more precise definition of the proposals McCone had presented in the authorization hearings. Pittman tied the plan directly to the five objectives McCone had proposed to the Joint Committee early in 1959, but each objective was now carefully defined in quantitative terms where appropriate or properly qualified to reflect recent developments in the world's energy outlook.⁴⁰

The most dramatic change had occurred in projections for conventional fuels in Western Europe. Early in 1957 the Three Wise Men from EURATOM had predicted that Europe would need to import 100 million tons of coal annually within five years unless electric-energy requirements could be met with nuclear power. Scarcely two years later, in spring 1959, Floberg reported to the Joint Committee that Europe had 50 million tons of coal above ground. The price in Europe had dropped five dollars per ton in the face of reduced shipping rates for American coal, new sources of natural gas, and new oil discoveries in the Middle East. All these factors had dampened at least the short-term urgency of nuclear power and thrown the long-term projections into question. "With fingers crossed and eyes raised heavenward," as a *Nucleonics* reporter put it, the United States and EURATOM had issued an invitation to European utilities to submit proposals by September 1, 1959, for six to eight reactor plants. With the coal glut and the leveling off of electricity demand, it seemed unlikely that more than one proposal would be submitted.⁴¹

The changing outlook for EURATOM had forced Pittman to modify the Commission's interpretation of its second objective, which was to assist friendly countries to achieve competitive nuclear power within five years. When the objectives were first formulated in 1958, the overseas market for nuclear power was the driving force behind the United States' civilian power program. Without the threat of British and Soviet competition for the European reactor market, there would have been little justification for accelerating the construction of power reactors at home. Now, in early 1960,

with the European market all but vanishing, the objective was reinterpreted to mean only that the United States would assist friendly nations through cooperative arrangements on research and development directly related to the Commission's needs for its domestic power program. The less promising European outlook also required some modification in the fourth objective, which was to maintain the United States' position of world leadership in nuclear power technology. As competition for the European market declined, it was no longer essential that the nation maintain its preeminence in developing every reactor type. Now, in 1960, the nation could afford to pursue only the most promising avenues to competitive nuclear power, and these were being defined by McCone, Pittman, and the Commission.

510 The central focus of the long-range plan thus became the evaluation of reactor types for the domestic electric power market. Here the Commission's first, third, and fifth objectives were controlling. The first was simply stated: "Reduce the cost of nuclear power to levels competitive with power from fossil fuels in high energy cost areas of this country within ten years." The draft specified that the ten-year period would be counted from 1958 and defined what was meant by "competitive power" in quantitative terms, how the cost of fossil-fuel power was to be computed, and what were "high cost power areas." The third objective was interpreted to mean that the Commission would continue to support research and development over a longer term in order to reduce the cost of nuclear power even further. The fifth objective, which the ad hoc committee had long advocated, was to develop breeder reactors to make full use of the limited resources of fissionable material. The draft of the long-range plan noted that uranium reserves would probably be adequate "for at least the next fifty years." This conclusion meant that breeder development should be guided primarily by economic considerations and was therefore not a high priority.⁴²

By the time the Commission approved the final draft in February 1960 the long-range plan had expanded from a concise internal policy paper into an encyclopedic public document that not only presented the Commission's recommendations but also protected the Commission's flanks against ambush by the Joint Committee or the nuclear industry. In addition to listing the projects directly related to nuclear power development, the plan also cited military projects and the *Savannah* as contributing to the effort. Like all Commission proposals since autumn 1958, the long-range plan placed the greatest emphasis on reactors moderated by light water and organic fluids. The Commission held to its conviction that pressurized-water reactors were the best understood of all reactor types. They were "safe, dependable, and reasonably easy to control." Now that one manufacturer was already offering a large central-station nuclear plant for a fixed price with some fuel guarantees, the Commission concluded that pressurized-water reactors would be competitive in high-cost areas of the United States by 1968. In addition to the experimental reactors and proto-

Table 3
Reactors Included in the Commission's Long-Range Plan,
February 1960

<i>Project</i>	<i>Type</i>	<i>Design power (kwe)</i>	<i>Status</i>
<i>Pressurized-Water Reactors</i>			
Pressurized Water Reactor Shippingport, PA	Co-op	150,000	Operating, to be modified
Yankee Atomic Electric Co. Rowe, MA	Utility	110,000	Construction
Consolidated Edison Co. of New York, New York, NY	Utility	225,000	Construction
Pennsylvania Power & Light Liberty, PA	Utility	5,000	Construction
Process Heat Experiment, CA	Government	—	Planned
Prototype	Co-op	22,000	Invitations issued
<i>Boiling-Water Reactors</i>			
Experimental Boiling Water Reac- tor, Argonne, IL	Government	4,500	Modification
Rural Co-op Power Assoc. Elk River, MN	Co-op	22,000	Construction
Vallecitos Reactor Livermore, CA	Manufacturer	5,000	Operating
Dresden Nuclear Power Station Morris, IL	Utility	180,000	Construction
Pacific Gas & Electric Humboldt Bay, CA	Utility	48,000	Site work
High Power Density Prototype	Co-op	50,000— 75,000	Design
<i>Nuclear Superheat Reactors</i>			
Borax-5, National Reactor Testing Station, ID	Government	3,500	Design
Pathfinder, No. States Power Co. Sioux Falls, SD	Co-op	62,000	Design
Bonus, Puerto Rico Water Resources Authority	Co-op	16,300	Design
<i>Organic-Cooled Reactors</i>			
Organic Moderated Reactor Exp. Nat. Reactor Test Station	Government	150	Modification
Exp. Organic Cooled Reactor NRTS	Government	10,000	Design

(continued next page)

Table 3, cont.
Reactors Included in the Commission's Long-Range Plan,
February 1960

<i>Project</i>	<i>Type</i>	<i>Design power (kwe)</i>	<i>Status</i>
<i>Organic-Cooled Reactors</i>			
Prototype, City of Piqua, OH	Co-op	11,000	Construction
Prototype	Co-op	50,000– 100,000	Invitation issued
<i>Sodium-Cooled Fast Reactors</i>			
Exp. Breeder Reactor No. 1 Nat. Reactor Test Station	Government	150	Operating
Exp. Breeder Reactor No. 2 Nat. Reactor Test Station	Government	16,500	Construction
Consumers Public Power	Co-op	75,000	Construction
<i>Gas-Cooled Reactors</i>			
Exp. Gas Cooled Reactor Oak Ridge Nat. Lab.	Government	22,000	Design
Philadelphia Electric High Temperature Reactor	Co-op	28,500	Design
<i>Heavy-Water Reactors</i>			
Components Test Reactor Savannah River, SC	Government	61,000	Design
Florida East Coast & West Coast Groups	Co-op	50,000	Evaluation of concept
<i>Other Concepts</i>			
Aqueous Homogeneous	Advanced Epithermal		
Fused Salt	Slurry		
Fluidized Bed	Pebble Bed Gas-Cooled		
Paste or Suspended Fuel	Solid Moderated, Steam-Cooled		
Supercritical Water-Cooled	Alternate Coolant Fast Reactor		

types already under construction by the government and industry, the Commission announced its intention to build one additional prototype based on technology growing out of the operation of the Shippingport, Yankee, and Consolidated Edison pressurized-water plants.⁴³

Boiling-water reactors, the Commission concluded from experimental reactors already operating, were technically feasible and would soon begin commercial operation in new plants of this type at Morris, Illinois, and elsewhere in the Midwest. The Commission intended to negotiate contracts with public or private utilities to construct, beginning in 1960, two prototypes to demonstrate technical improvements on boiling-water reactors. The need for further prototypes could not be determined until operat-

ing experience with all existing or planned boiling-water reactors had been evaluated, probably in 1963 or 1964. To achieve greater efficiency in both pressurized-water and boiling-water plants, the Commission was supporting one experimental reactor and two prototypes under cooperative agreements with industry.

The Commission predicted that organic-moderated reactors would become competitive in high-cost power areas of the United States by 1967 or 1968 and in most of the nation in the 1970s. A second reactor experiment at the Idaho test station and two prototypes—one under construction at Piqua, Ohio, and another planned—were expected to bring organic reactors into competition. Sodium-cooled reactors appeared capable of becoming competitive in large areas of the nation in the 1970s. A second experimental breeder reactor at the Idaho test station, the Enrico Fermi plant in Michigan, and development of auxiliary power systems for space vehicles were all expected to contribute to the technology of fast-neutron breeder reactors and might lead to a decision to build a prototype by 1963 or 1964. The future of sodium-cooled graphite-moderated reactors rested on results from continued operation of the sodium reactor experiment in California and the Hallam plant in Nebraska. No prototypes would be considered before 1963 or 1964.

Gas-cooled reactors were still considered promising for high-temperature operation but not until the 1970s. In the meantime the Commission planned to develop the technology with a new experimental reactor at Oak Ridge, the Philadelphia Electric prototype, and experimental reactors in Idaho. As for reactors moderated with heavy water, the Commission's long-range plan revealed that the United States would depend on a Canadian prototype and a full-scale plant in Ontario to carry the development burden. American efforts on heavy-water technology would be limited to a test reactor for components at the Commission's Savannah River plant and a cooperative prototype project with two Florida utility groups. Even farther in the future than the gas-cooled and heavy-water reactors were a dozen or more reactor types whose development had not progressed much beyond preliminary paper studies.

The long-range plan was admittedly ambitious. No one understood better than McCone that its accomplishment rested on a number of shaky assumptions. The most immediate uncertainty was whether the budget-tending Eisenhower Administration would provide the necessary funding. Even if it did, McCone knew that success also depended upon continuing financial and technical participation by private industry. It was not at all clear in spring 1960 that utilities would respond to invitations for prototypes, the essential step toward large central-station generating plants. The greatest uncertainty of all, however, was whether technological development over the next decade would fulfill the Commission's hopes. For many reactor types, technical feasibility was still an open question, and, even if

the answer were positive, there would still be the much more difficult question of costs.

In just two years McCone and Pittman had made significant strides in bringing systematic evaluation and planning to bear on the Commission's amorphous and inflated programs for developing nuclear power. Realistic appraisal had helped to focus the Commission's efforts and to present a comprehensible and credible plan. That same appraisal, however, made clearer than ever before that nuclear power at prices attractive to electric utility companies in the United States was not yet assured. The dream that the power of the peaceful atom might solve the world's growing energy needs was still far from reality.

CHAPTER 19

SCIENCE FOR WAR AND PEACE

The 1950s were a decade of spectacular achievement in nuclear science and technology. Less than twenty years after the initial experiments that had brought the world into the nuclear age, scientists and engineers were finding many applications for both military and peaceful purposes. This rapid transition from first experiment to widespread application seemed to have few precedents in the history of science and technology, but it was by no means unique. During this same decade other technologies were developing just as rapidly, and some of these were threatening to render obsolete some goals of nuclear programs. After years of desultory progress, the jet engine for aircraft was rapidly coming into its own. The invention of a practical transistor to replace the vacuum tube was revolutionizing the electronics industry and opening the way to the computer age. With solid-state circuits for use in guidance systems and steady improvement in the design of rocket engines, the Soviet Union and the United States were on the threshold of the missile age. These and other technologies were to have both dramatic and subtle effects on the practical application of research and development projects supported by the Commission.¹

The most startling development during the 1950s outside the nuclear field had been the astounding progress in perfecting missile propulsion systems. The awesome symbol of that achievement had been *Sputnik I*, launched by the Soviet Union in autumn 1957. *Sputnik* shook the United States like no other Soviet accomplishment in the decade. The orbiting Soviet satellite proclaimed to the world the inferior position of the United States in missile development. Even worse, it suggested that the technological dominance that the United States had maintained since World War II was beginning to crumble. Most serious of all, *Sputnik* raised the possibility that the United States had missed the greatest technological opportunity of the decade and dedicated its resources to lesser projects.

The American reaction to *Sputnik* was a feverish effort to improve the nation's scientific and technical capabilities, all the way from restructuring secondary school education in the sciences to giving scientists a stronger voice in the highest policy councils of the federal government. During the last three years of the Eisenhower Administration the special assistant to the President for science and technology and the President's Science Advisory Committee gave scientists and engineers the greatest influence on national policy decisions that they have enjoyed before or since. Thus, Chairman McCone would find James R. Killian and his successor, George B. Kistiakowsky, persons to be reckoned with in his dealings with the White House.

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Within the Department of Defense the new emphasis on science found expression in the appointment of Herbert F. York as director of the new office of defense research and engineering. A capable and personable physicist who had been director of the Commission's Livermore laboratory and the Advanced Research Projects Agency in the Department of Defense, York was to have an effective voice in policy decisions on both weapon development and test-ban negotiations. Thomas Gates, Jr., who served first as Under Secretary of Defense and later as Defense Secretary during McCone's chairmanship, recalled years later: "All of a sudden the scientists became very important. . . . They had great veto power. They became very important people. . . . The world really completely changed, in terms of military affairs. And foreign policy changed with it."²

The new role for the scientist did not just mean that McCone would have additional competitors for the ear of the President; it also meant that the substance of science would have a more prominent place in presidential decision making. Assessment of the Commission's military propulsion projects by scientists revealed the need for more attention to basic scientific research and less concern for quick demonstrations of hardware with little or no practical value. In international affairs, the President's long quest for a test ban and disarmament would move away from political considerations into new realms of thresholds and seismic decoupling that required sophisticated scientific analysis.

AIRCRAFT REACTORS

An immediate consequence of *Sputnik* was a renewed effort by the Joint Committee to accelerate the development of nuclear propulsion for military aircraft. The committee's championing of Rickover's projects for a nuclear navy encouraged Democratic members, especially Congressman Melvin Price, to take a similar position on aircraft propulsion in hopes that it would lead to an equally spectacular success. Caught up in the *Sputnik* fever in autumn 1957, the Commissioners received Price's letter favorably and

seized upon a proposal by General Electric to flight-test an aircraft reactor by 1960, provided that the government furnish additional funding for a "crash" program. Only Commissioner Libby demurred on the grounds that this approach would probably not lead to a useful propulsion system.³

In many respects there had been substantial progress in development since summer 1953. Experimental facilities at Oak Ridge had been greatly expanded, and private contractors had built large laboratories especially equipped for development of the two approaches: General Electric on the direct cycle near Cincinnati and the Pratt & Whitney Division of United Aircraft on the indirect cycle near Hartford, Connecticut. Both contractors had completed extensive design studies and component testing, and General Electric was operating a small reactor to test the performance of fuel elements.

The fact was, however, that more than \$600 million and five years later, the United States was not much closer to an aircraft reactor than it had been in summer 1953. General Electric's test reactor appeared significant only if the Air Force were prepared to accept a nuclear-powered aircraft with low performance capabilities. Pratt and Whitney had just switched to a new concept for the indirect cycle and was only beginning to explore the problems of handling liquid-metal coolants at temperatures above 1,800 degrees Fahrenheit. Both contractors could suggest several military applications for the reactors they were developing, but in almost every case new designs of conventional aircraft offered superior performance at an earlier date.⁴

Armed with this information McCone joined the Department of Defense early in 1959 in recommending to the President a substantial cut in funding for the project, from \$145 million for the Air Force and \$95 million for the Commission in 1960 to \$75 million for each agency. McCone, Kilian, and others would have liked to eliminate one approach altogether, but in the post-*Sputnik* era that was unthinkable. Both approaches would be continued, but the contractors were instructed to concentrate on developing reactor components rather than complete engine prototypes.⁵

Price attempted to force the hand of the Executive Branch by calling a series of hearings before his subcommittee, one of which, in July 1959, was the first open hearing ever held on this topic. McCone favored further development if the project could be cut to one approach, but that was not feasible politically. When the Joint Chiefs of Staff refused to establish a clear-cut requirement for a nuclear-powered plane, Secretary Gates recommended to Eisenhower that the Administration scrap all plans for building prototype planes and limit development on both approaches to high-temperature research on reactor materials and components. On York's recommendation, the Department of Defense decided to terminate several unpromising development projects. With some reluctance the Commission accepted the reduction.⁶

McCone would have preferred to continue closely monitored research on both approaches and to make plans for a prototype of the indirect cycle, but the absence of a military requirement and opposition in the Bureau of the Budget precluded that course. Behind the scenes the influence of York and Kistiakowsky was decisive. York thought much of the research misdirected and tried to hold costs down to those politically necessary. Kistiakowsky sharply criticized General Electric for spending "about one-fourth of a billion dollars" on an engine that appeared useless; he considered the project "largely a political issue" and "definitely a technical failure." The President was inclined to take an even stronger position than did York and was not especially worried about the political implications.⁷

A further objection to nuclear-powered aircraft, one seldom voiced in public, was the potential radiation hazard. Even with extensive shielding the crew would be exposed to enough radiation to limit the number of hours that they could spend in the plane. Very expensive devices would be necessary to protect ground crews, and there was always the danger of radiation exposure of the public in the event of a crash. Another consideration was that the direct-cycle engine, which would feed the turbine with air coming directly from the reactor core, would continuously release measurable amounts of radiation to the atmosphere. Late in 1959 the Commission established an aerospace nuclear safety board to study the potential hazards of nuclear-powered aircraft and space vehicles.

By the end of 1960 virtually all support for nuclear-powered aircraft had evaporated except within the Commission and the Joint Committee. Probably hoping for better days in the Kennedy Administration, the Commission's aircraft reactors branch confidently announced plans for carrying both approaches forward to the operation of test reactors in the coming decade. One of President Kennedy's first decisions in 1961, however, was to kill the project after fifteen years of sophisticated and expensive research.⁸

ROVER AND PLUTO

Since 1956 two weapon laboratories had been working on propulsion systems for unmanned air and space craft: Los Alamos on Project *Rover*, to develop a reactor for rocket propulsion; and Livermore on Project *Pluto*, to develop a nuclear ramjet that would propel a missile at low altitudes and supersonic speeds. Once the laboratories had investigated the high-temperature properties of various materials, experimental reactors were designed and built in a 500-square-mile area that the Commission acquired near the Nevada Test Site. Los Alamos completed the first test of an experimental reactor using gaseous hydrogen as a propellant on July 1, 1959. Two further tests using the Kiwi-A reactor with cores designed for higher

power levels and more stringent operating conditions were completed in summer and fall 1960. Livermore operated the first test reactor in Project *Pluto* at the test site in December 1960. Although all the tests gave some promising results, fundamental problems remained in obtaining reliable performance with high-density, high-temperature reactors; and, as in the case of the manned aircraft, the fast pace of development in conventional propulsion systems was outstripping the nuclear approach. Thus, neither York nor Kistiakowsky was willing to recommend a high priority for these projects. Like the aircraft systems, *Rover* and *Pluto* did not survive the 1960s.⁹

AUXILIARY POWER FOR SPACE VEHICLES

Although the Air Force had asked the Commission in 1955 to develop a nuclear unit that would provide electric power for a missile, *Sputnik* sparked support for a full-fledged effort. An Air Force requirement for SNAP-1, a radioisotope-heated generator, had already been cancelled; but the contractor, the Martin Company of Baltimore, used the SNAP-1 technology to build a somewhat larger unit, SNAP-3, which President Eisenhower announced with much fanfare in January 1959. SNAP-3 weighed five pounds, had no moving parts, and produced 2.5 watts of electricity. Before the end of 1960 Martin had built and tested SNAP-5 and was working on SNAP-7A and -7B, 5-watt and 30-watt units to be used by the Coast Guard in light buoys. At the same time Atomics International was developing a family of SNAP devices that employed small reactors rather than radioisotopes as a power source. An experimental version of SNAP-2 reactor, designed to provide three kilowatts of electricity for a space vehicle, was completed in November 1959 and operated at full power for a year. By that time the turboelectric conversion equipment was being tested and the completed unit was scheduled for space flight in 1964. Two larger reactor generator systems, SNAP-8 and -10, were already under development. By comparison with aircraft propulsion, SNAP was still a miniscule project in 1960; total expenditures since 1955 had been less than \$13 million. During the 1960s, however, the exceptional performance of SNAP-2 and its descendants in space missions would make the program the most successful of all the air and space projects.¹⁰

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REACTORS FOR THE ARMY

The reactors the Commission developed for the Army during the 1950s did not present the severe technological challenges of the aircraft projects. The initial aim was to create relatively small power reactors that could be as-

sembled in remote areas to generate electricity for Army installations. With an emphasis on simple design and high reliability, the Army projects did not involve high risks in either government funding or international prestige. Thus, they did not command the attention of McCone, York, Kistia-kowsky, or the President.

The first project was the Army package power reactor, a smaller and simplified version of the pressurized-water reactor derived from Shipping-port technology. Completed in 1957 at Fort Belvoir, Virginia, the 1.9-megawatt plant continued to operate for more than a decade, first as an experiment and then as a training reactor and power generator. It was also the precursor of a larger stationary power plant at Fort Greeley, Alaska, and three portable plants—at Fort Sundance, Wyoming; Camp Century in Greenland; and McMurdo Sound, Antarctica—all completed and operated in the 1960s. Although these plants produced useful power for about a decade, they proved in the long run too difficult and costly to maintain and were eventually decommissioned. The Commission also sponsored research for the Army on small boiling-water and gas-cooled reactors, but neither of these was pursued beyond the experiment stage.¹¹

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THE NUCLEAR NAVY

The spectacular performance of the *Nautilus* in sea trials and fleet maneuvers in the spring and summer of 1955 convinced Admiral Arleigh A. Burke, the new chief of naval operations, that all new submarines built for the fleet should be nuclear-powered. He promptly added three more to the three nuclear submarines authorized for 1956 and asked the bureau of ships to study the feasibility of using nuclear power in frigates, guided-missile cruisers, and attack carriers for the surface fleet. Then he spurred the Navy's lagging efforts in missile development and selected Rear Admiral William F. Raborn to head a special projects office in the bureau of ordnance to begin research on the Navy's launching system.¹²

Anticipating that the success of the *Nautilus* would lead to burgeoning requirements for nuclear ships, Rickover and his staff had already launched the development of new types of reactors to meet this demand. Using the technology produced in building the S2W propulsion plant for the *Nautilus*, Westinghouse was completing a new pressurized-water reactor, the S3W, which the Navy expected would become the standard reactor system for the submarine fleet. Despite the significant advances required over the *Nautilus* plant, Westinghouse was able to bypass the prototype and move directly into final design and procurement. The keel for the *Skate*, the first of three submarines to use the new reactor, was laid at Groton, Connecticut, on July 21, 1955; the same day the *Seawolf*, containing General Electric's S2G sodium-cooled plant, was launched at the same Electric

Boat shipyard. Rickover had also wheedled permission to resume design studies for an aircraft-carrier reactor at Westinghouse. Thus, he could respond promptly to Burke's interest in nuclear-powered surface ships by starting construction early in 1956 of the A1W, a land-based prototype, to be completed at the Idaho test station in 1958.¹³

It was also apparent, however, before the end of 1955 that the S3W (and its modification, S4W) would not take full advantage of the potential capabilities of a nuclear submarine as demonstrated by the *Nautilus*. Rickover and Westinghouse were suddenly required to shift emphasis from the S3W to a larger, more powerful plant, the S5W, which did become the standard reactor for the submarine fleet. The keel for the *Skipjack*, the first submarine to use the S5W plant, was laid at Groton in May 1956. Westinghouse received a steady flow of orders for S5W plants, not only for attack submarines but also for the missile-carrying Polaris ships, first authorized in the crisis response to *Sputnik* in 1958. By the end of 1960 the Navy had authorized thirty-seven submarines using the S5W plant: twenty-three attack and fourteen Polaris.

The A1W prototype, consisting of two propulsion reactors for surface ships, continued to operate during 1959 and 1960 to provide design data and crew training for the aircraft carrier *Enterprise*, which was launched at Newport News, Virginia, on September 24, 1960. The *Enterprise* would use eight A2W reactors, while the guided-missile cruiser *Long Beach*, under construction at Quincy, Massachusetts, would use two reactors. Work was in the early stages at West Milton, New York, on the D1G prototype for the frigate *Bainbridge*, also to be built at Quincy.

For many Americans the most impressive demonstrations of Rickover's accomplishment were the highly publicized sea adventures of the first nuclear submarines in the late 1950s. The *Nautilus* in July 1957 was the first submarine to maneuver for any distance under the Arctic ice. The following summer the *Nautilus* traversed the northern passage from west to east under the ice and surfaced at the North Pole. The new submarine *Skate* followed the same course in 1959, this time in winter, and surfaced ten times. By 1960 two more nuclear submarines had made the trip, and three Polaris vessels were operating. In May the radar-picket submarine *Triton*, powered with two S4G reactors, made a 36,000-mile voyage around the world without surfacing. These ventures were more than Jules Verne escapades; they had obvious implications for nuclear warfare in the missile age.

Some insiders, especially McCone, were impressed by Rickover's ability to get results. The admiral, it appeared, had succeeded where all others, including the Russians, had failed. He was not only actually building a nuclear navy years before most nations could even aspire to the idea but also creating the network of designers, suppliers, and fabricators needed to support a permanent technology. McCone appreciated these facts, and he was not about to sacrifice this advantage. He took a hard line

in opposing the efforts of the Departments of State and Defense to honor a commitment made by Eisenhower in Paris in December 1957 to make nuclear submarine technology available to NATO countries. When the first request came from the Netherlands in spring 1959, McCone flatly opposed any cooperation and began reluctantly to draft an agreement only when Eisenhower ordered him to do so in September. Even then, McCone came up with a plan that would have delayed transmittal of classified information to the Dutch for two years. McCone, with the support of his fellow Commissioners and the Joint Committee, continued to drag his feet on the agreement for another year. By the time the President prodded him again in October 1960, it was too late to take any action on the agreement during the Eisenhower Administration.¹⁴

HIGH-ENERGY PHYSICS

The Commission under Strauss's leadership saw American preeminence in the nuclear sciences as a key element in the Atoms-for-Peace program. To supplement the Berkeley bevatron and the Brookhaven cosmotron the Commission had approved construction of the much more powerful alternating-gradient synchrotron at Brookhaven, the zero-gradient machine at Argonne, the Cambridge electron synchrotron, and the Princeton-Pennsylvania proton synchrotron. At the same time the Commission was still entertaining a proposal from the Midwest Universities Research Association for another accelerator in the Great Lakes area. Behind these decisions lay the conviction that, by continuing to set the pace for all other nations in the most prestigious field of physical research, the United States could demonstrate its clear superiority over the Soviet Union. Thus, like other Atoms-for-Peace programs, high-energy physics had become an instrument in the Cold War.

McCone was just as enthusiastic as Strauss about staying ahead of the Russians in scientific research, but he was less easily swayed by the high-sounding appeals used by promoters of science to win Commission support for their projects. American preeminence in science was a worthy objective, but were the proposals from the national laboratories and the universities likely to serve that end? As he did in evaluating all Commission programs, McCone took nothing for granted; proponents were expected to show that their plans were realistic, their budgets reasonable, and the results worth the cost.

As an engineer, McCone tended to take a jaundiced view of scientists. Like Rickover, he understood the indispensable role that scientists played in establishing the base for technological innovation, but he did not quite accept the idea that turning scientists loose in the laboratory to pursue their own interests in basic research was always a good investment for the

federal government. He visited the laboratories and questioned the scientists. By fall 1958 he was decidedly uncomfortable with the Commission's programs in high-energy physics. Were all those expensive accelerators necessary? Or had the Commission compromised in the face of competitive demands from the laboratories by giving each its own machine?

Willard Libby, who by this time understood McCone as well as his fellow scientists, suggested that it might be helpful to establish an interagency council to review federal policies for supporting high-energy physics. During summer 1958 Libby had met with Killian and Alan T. Waterman, director of the National Science Foundation, to draft a charter for the council. As a strategy, the group proposed that the Commission should assume responsibility for constructing large accelerators in the future and that the Department of Defense and the National Science Foundation should share funding with the Commission. The council, reporting directly to the President, would consist of senior officials from the three agencies, supported by technical staffs from the agencies and advisers from the laboratories and universities. Once established, the council would be expected to recommend to the President during fall 1958 "the construction of at least one new major accelerator."¹⁵

McCone accepted the proposal, probably because it promised financial help from other agencies and kept control in the hands of federal officials and not the scientists. It was hardly surprising, however, that the White House did not create a panel with the prestige and independence proposed. Instead, Killian appointed a panel of independent scientists under the President's Science Advisory Committee to make recommendations to him rather than directly to the President.¹⁶

The panel, headed by Emanuel R. Piore, a physicist who was director of research at the International Business Machines Corporation and a member of the Science Advisory Committee, lost no time in preparing its report. The panel urged sharp increases in federal support for high-energy physics from an annual rate of \$59 million in 1959 to \$125 million by 1963, without taking away funds from other areas of basic science. Highest priorities were for a linear accelerator capable of pushing electrons to energies as high as 10 billion electron volts (GeV) and a high-intensity proton accelerator of at least 8 GeV. For the linear accelerator, the panel recommended the proposal that Stanford University had been developing since 1956. The spark plug of the Stanford project was Wolfgang K. H. Panofsky, who as a graduate student had helped Luis W. Alvarez build the first linear accelerator at Berkeley in 1946. Talented and self-confident, Panofsky was accustomed to thinking big when it came to physics.¹⁷

The scale of Panofsky's plan matched his reputation. The accelerator, approximately two miles in length, would cost \$100 million and would take six years to build. The accelerating tube would be placed in a tunnel ten feet wide and deep enough underground to provide necessary shielding.

A parallel tunnel, twenty-four feet in width and separated from the first by thirty-five feet of earth for shielding, would contain the 240 ultra-high-frequency klystron tubes that would supply power to the accelerating electrodes through which the electrons would pass on their way to the target. The proposed accelerator would provide an electron beam with the highest energy in the world and with fifty times the intensity of a circular machine.¹⁸

524 When Eisenhower met with Killian and the Piore panel on April 2, 1959, he reacted favorably to the proposal for the Stanford accelerator and to substantial expansion of high-energy physics in general, although it was not at all clear whether he approved the expenditure levels proposed in the Piore study. In a speech in New York on May 14, Eisenhower publicly committed his Administration to the project, but McCone took no precipitous action to carry out the decision. In August he asked General Manager Luedecke to make an intensive investigation of the technical, financial, and administrative plans for the project. These studies by a group of outside consultants led to other questions, including the possibility of a conflict of interest between Stanford University and some of its consultants.

McCone's greatest concern, however, was the skyrocketing cost of research in high-energy physics. He told members of the Joint Committee in Albuquerque on December 9 that accelerators posed "one of the most disturbing problems" that he had faced on the Commission, and he reported to his fellow commissioners that the increasing costs were "alarming" to both him and the committee members.¹⁹

Kistiakowsky, who by now had replaced Killian as the President's science adviser, grew more impatient as McCone continued to question the priority assigned to high-energy physics. When McCone suggested that the Commission appoint an independent advisory group to reexamine the question, Kistiakowsky and scientists at the Commission turned this suggestion into a decision to reconvene the Piore panel, which promptly reaffirmed the recommendations in its first report, including a high priority for the Stanford accelerator. Kistiakowsky wrote McCone that he could understand the chairman's concern over ever-increasing costs, but he observed that "the Federal Government [had] committed itself to support of science in order to further national welfare, health, security and prestige." In the space program, international prestige was sufficient justification alone. In high-energy physics "the selection [could] be based more on scientific grounds: the promise of the most fundamental contributions to human knowledge and therefore the anticipation of the most far-reaching effects on human future." Eisenhower found this argument persuasive when Kistiakowsky presented the Piore report to him on March 23. McCone later that day told the Commission that "while the President was impressed with the cost implications of this program, he felt that the work was so important to science and to the

prestige of the United States, there was no alternative but to go forward.”²⁰

This time McCone accepted the President's decision and set in motion the administrative actions necessary to start design and engineering in 1961. By working closely with Senator Anderson and the Joint Committee, he was able to thwart any efforts by the scientists to rush headlong into construction without extensive engineering studies. Although the Commission requested authorization for the entire project, McCone was probably not unhappy when the Joint Committee supported authorization for only one year and then only for design and engineering. McCone, however, was not yet ready to accept an open-ended commitment to high-energy physics in general. In September he asked Kistiakowsky to reconvene the Piore panel a third time, to examine the long-term needs for accelerators. After a series of meetings during fall 1960 the panel came up with sweeping recommendations for continuing expansion of high-energy physics with federal support. In addition to meeting the increasing costs for building and operating accelerators already under construction (estimated at close to \$200 million by 1970), the federal government was asked to increase support for university research and to finance several new accelerators as the need arose. All these additional projects would push federal expenditures for high-energy physics close to \$400 million annually by 1970. To assuage McCone's dismay, Kistiakowsky admitted that the recommendations represented an optimum program from the scientists' perspective and did not consider the needs of other research or budget constraints. Still, the panel report raised important questions about the role of the federal government in the new era of scientific development, questions that would continue to haunt succeeding administrations.²¹

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FUSION: A RETURN TO SCIENCE

During Lewis Strauss's term as chairman, Commission support of controlled thermonuclear research had grown rapidly from less than \$1 million in 1953 to \$10 million in 1957. The first three years had been a time of unrestrained optimism as scientists at Los Alamos and Berkeley joined those at Princeton in the search for a controlled thermonuclear reactor. While Lyman Spitzer and others at Princeton devised ways to circumvent technical difficulties encountered in experiments with the stellarator, James L. Tuck at Los Alamos and William R. Baker at Berkeley saw a possible shortcut to an operational system in the new linear pinch machines that they were developing. Tuck, who was usually cautious in his judgments, saw 1955 as "the greatest thrust forward" yet made in Project *Sherwood*.²²

Before the end of 1957, however, the same kinds of "technical"

problems that haunted Princeton were beginning to dampen enthusiasm in the western laboratories. When the Commission during the fall seemed determined to use fusion development as the centerpiece for the United States exhibit at the 1958 Geneva conference, few scientists involved were comfortable with the idea, especially when Strauss proposed that the fusion display should be the world's first demonstration of thermonuclear neutrons. The neutrons copiously produced in pinch devices in the United States, the United Kingdom, and the Soviet Union, which had elated scientists in 1955, had all turned out to be spurious; and there was little hope that such a demonstration could be accomplished at Geneva. Oak Ridge had now entered the field as the fourth laboratory pursuing the fusion goal, but the experimental work there was only beginning. Even a near doubling of the funding and Strauss's personal encouragement could not achieve his goal. The fusion exhibit at Geneva turned out to be a dazzling display of American ingenuity and commitment, but it failed to provide evidence that the successful extraction of energy from the controlled fusion reaction was imminent. The outcome was a clear example of the truism that politics and money cannot always drive technology.

Strauss, in his enthusiasm to recapture for the United States world leadership in scientific development, which the Soviets had seized with *Sputnik*, had ignored several trends that had been changing the character of thermonuclear research since 1956. First, there was growing realization that a practical fusion reactor would not be a simple extrapolation of an experimental device being operated in the laboratories. The troublesome "technical" problems were not the only obstacles to success. Behind them lay a failure to understand fully the physics affecting the process. The fusion scientists, if not Strauss, were convinced that they would have to give up cut-and-try efforts to finesse their way to a practical reactor and instead return to basic theory and experiments.

Second, closely related to the first trend was the growing realization among scientists that success depended upon declassification of the project and the opening of fusion research to the free exchange of ideas. The Commission staff had been advocating declassification since 1953. Although the scientists agreed in principle, they hesitated to take a strong stand on the issue in hopes that a successful reactor could be developed before the security wraps were removed. As that possibility grew more remote, the scientists took up the cause of declassification in 1956, only to encounter the unyielding opposition of Strauss. As a compromise the Commission had agreed to declassify basic research in fusion physics, so long as it did not relate to the design of practical reactors. Not until Strauss had left the Commission did it completely declassify all work on fusion and then mostly for a short-term political advantage on the eve of the Geneva conference.

Third, stemming directly from the second trend, was the movement

of the fusion project away from exclusive Commission control toward the normal patterns established in academic and industrial research. With basic research declassified, some university scientists began to give more attention to plasma physics, and industry was ready to participate when the Commission made classified data available in 1956 to holders of access permits. General Electric promptly set up an ambitious program, Westinghouse kept two physicists working at Princeton, and Allis-Chalmers and the Radio Corporation of America received a contract to do detailed engineering for a new and larger stellarator at Princeton. In 1957 General Atomic, a division of General Dynamics, joined forces with a group of utility companies in Texas to study with private funding the long-range technology of fusion reactors.²³

McCone, following the same course that he had adopted in high-energy physics, encouraged these trends in the fusion program. Declassification and the opening of research to academic and industry scientists impressed McCone as not only a healthy move but also one likely to reduce federal expenditures. Within weeks of becoming chairman, he instituted his standard procedure of asking the Commission staff for a complete review of the fusion program. His first observation was that annual expenditures had risen from \$10 million in 1957 to \$26 million in 1959 and were projected at \$36 million in 1960. Much of the increase, he noted, was to support Strauss's intensive effort for the Geneva exhibit, and he suggested that costs could be cut for normal development. McCone also asked the staff to consider reducing the number of fusion experiments. Recognizing that a fusion reactor was now likely to be the product only of long-term basic research, an advisory committee of scientists accepted a 10-percent cut in funding but insisted upon continuing all four approaches. Under McCone, fusion no longer received preferred treatment from the chairman but rather became one of many research projects competing for Commission funding.²⁴

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Once the Commission had opened the doors to independent research on fusion, scientists in the universities began to establish the usual appurtenances of a conventional research field. Late in 1959 Melvin Gottlieb of Princeton took steps to create a division of fluid dynamics within the American Institute of Physics to replace the closed, classified *Sherwood* conferences that the Commission had sponsored until spring 1957. A steady stream of articles on fusion research appeared in the *Physical Review* until a new specialized journal, *Physics of Fluids*, could be published. The Massachusetts Institute of Technology, Princeton, and other universities soon organized graduate programs in high-temperature plasma physics and engineering. As the number of graduates increased in the early 1960s old-timers noted a gradual improvement in the quality of research. Perhaps the exciting "golden days" of fusion research were past, but, by the time

McCone left the Commission in 1961, the tortuous path toward the cherished goal of a virtually unlimited source of energy seemed to rest on much more solid ground than that explored in earlier years.

PLOWSHARE

When Lewis Strauss for the second time took the oath of office as a Commissioner in July 1953, he marked his Bible at the familiar passage in Micah: "And they shall beat their swords into plowshares, and their spears into pruning hooks; nation shall not lift up sword against nation, neither shall they learn war any more."²⁵ Although the new chairman had often professed his dedication to developing the peaceful uses of atomic energy, he probably did not suspect in summer 1953 how directly the biblical words could be applied to nuclear technology. Within three years, however, the promise of such a transformation appeared within reach.

Late in November 1956 Herbert York, then director of the Livermore laboratory, had raised the possibility of using the energy released from nuclear or thermonuclear reactions to produce power or plutonium, to dig excavations, or even to accelerate rockets. York reported growing interest in such applications, not only at Livermore but also at Los Alamos and Sandia, and he suggested that scientists from the three laboratories be permitted to hold a classified conference to discuss the possibilities. The Commission approved the conference, with the proviso that work on peaceful uses not interfere with weapon development.²⁶

Predictably the conference held at Livermore in February 1957 concluded that there was "a sufficient number of attractive possibilities" to warrant a few studies of "using clean nuclear explosive devices for non-military purposes." The potential applications indeed appeared attractive, but the Commission saw certain hazards in the proposal. One, already noted, was the danger of diverting scarce scientific talent and resources from weapon development. Even more troublesome would be the common technical characteristics of peaceful devices and weapons. If nuclear explosive devices were to be used for peaceful purposes, they would have to be available eventually to the civilian economy, but their similarity to weapons would make declassification of their design and use virtually impossible. For the time being, then, studies of the new devices were to be limited to Livermore, and the project would remain secret.²⁷

Still concerned about possible interference with weapon development, the Commission decided to limit the peaceful device project to \$100,000 through fiscal year 1959; but by autumn 1957 Livermore was already advocating a vast expansion of the project to include designing special devices for excavation and mining applications, studying the possibility of extracting heat and tritium from underground detonations, and

obtaining scientific data on underground shots. The proposal would require \$450,000 in 1958 and \$3 million in 1959. Although the Commission staff believed that Livermore was moving too fast, both Strauss and Libby advocated a program even larger than the laboratory proposed. In the end the Commission authorized the \$3-million figure, primarily for an earth-moving experiment in 1959, and asked the Bureau of the Budget to increase the 1959 budget by that amount.²⁸

Much of the Commissioners' enthusiasm stemmed from data just then available from *Rainier*, the first fully contained underground nuclear test. *Rainier* had demonstrated that no seismic or shock effects would interfere with mining operations following a nuclear detonation underground. Unable to contain his excitement, Libby told the *Washington Post* in December 1957 that he saw "very definite possibilities" in using nuclear explosions for peaceful uses. Referring to *Rainier*, Libby exclaimed, "I've not seen anything in years so exciting as this development." The Commission's semi-annual report to the Congress in January 1958 briefly described the Livermore project and named it Project *Plowshare*.²⁹

Commission interest in *Plowshare* grew rapidly in 1958, not only in terms of its potential peaceful applications but also as an opportunity to put a better light on weapon development. As Strauss noted in February, *Plowshare* was intended to "highlight the peaceful applications of nuclear explosive devices and thereby create a climate of world opinion that is more favorable to weapons development and tests." Growing public demand for a nuclear test ban in spring 1958 also suggested that the Commission should move quickly to demonstrate the value of *Plowshare* devices while testing was still permissible.³⁰

During his final weeks as chairman in June 1958, Strauss made certain that the future of *Plowshare* was in good hands. The Commission approved doubling the 1960 budget for the project to \$6 million. Livermore personnel assigned to the project would increase to almost one hundred, and firm plans were made to bring industry into full participation in *Plowshare* experiments. Teller, now officially director of the Livermore laboratory, pushed forward with specific plans for *Plowshare* experiments still focused on excavation and the production of power and isotopes. The laboratory would continue to design devices for digging canals and harbors and to study the phenomena of underground detonations. These studies were intended to lead to two full-scale experiments: Project *Chariot*, to excavate a harbor on the northwest coast of Alaska in the summer of 1960; and Project *Gnome*, an underground shot to be fired in a salt dome near Carlsbad, New Mexico, in summer 1959, to test the feasibility of producing fissionable material by this method.³¹

Despite Teller's strong leadership and vigorous lobbying in Washington, schedules for *Plowshare* experiments continued to slip during the last two years of the Eisenhower Administration. As Commissioner John S.

Graham pointed out to McCone in September 1958, the President's announcement of a moratorium on nuclear testing was likely to stimulate strong Soviet opposition and public sentiment against *Plowshare* experiments. Graham's prediction proved correct, and within a few weeks Soviet protests forced the Commission to cancel a meeting with oil industry representatives to discuss oil-shale experiments with *Plowshare* devices. Although the Commission continued to plan *Plowshare* experiments, McCone assured the State Department that no nationwide public announcements on *Plowshare* would be made pending the outcome of the test-ban negotiations scheduled to begin in October 1958. As those negotiations dragged on into 1959 and 1960, the schedule for *Chariot* and *Gnome* drifted with them.³²

INTERNATIONAL SCIENCE

By 1959 nuclear physics seemed the queen of the sciences. Kistiakowsky saw high-energy physics as the key to understanding the nature of the universe and thus of "uniquely fundamental scientific importance." It had "very high prestige value" and a "special appeal to many of the most able and creative scientists." The United States could not afford to forfeit its world leadership in a field that served as a touchstone of national superiority. Fusion experiments were considered equally critical, not so much for their fundamental character but because of their enormous potential as an energy source. These propositions, which the scientists continually invoked to justify government support, gave both high-energy physics and fusion special consideration in the Eisenhower Administration. Both fields offered opportunities for competing with the Soviet Union in the Cold War while advancing the Atoms-for-Peace program.³³

If high-energy physics and fusion research held the promise of a competitive advantage over the Soviet Union, they also generated proposals for international cooperation between the two superpowers. The idea that competitors could cooperate was nothing new to nuclear physicists, whose discipline was born at the turn of the century in an international environment. In 1952 physicists at Brookhaven had welcomed colleagues from the European Center for Nuclear Research and willingly shared with them the strong focusing principle that made possible a quantum jump in the energy capabilities of accelerators. The next step beyond the alternating-gradient synchrotron posed enormous theoretical and engineering problems that only the very best minds could hope to resolve. American physicists in 1958 took the lead in establishing a commission on high-energy physics within the International Union of Pure and Applied Physics. The commission, composed of two Americans, two Russians, and two physicists from Western Europe, laid plans for a series of international conferences to follow an earlier one held in Rochester, New York, in 1956. The next meeting was

planned for Moscow in 1959 and the third for Rochester in 1960. More immediately, the commission was charged to encourage international co-operation among high-energy laboratories in all countries "to ensure the best use of the facilities of these large and expensive installations." This goal could be accomplished by arranging for the rapid exchange of the latest experimental results.³⁴

International exchanges in fusion research were not so easy to arrange. Before 1955 everything related to fusion work in the United States had been classified, even the names of the laboratories where research was conducted. In 1956 the Atomic Energy Commission approved the exchange of scientists and information with Britain and then removed all restrictions on basic research not related to operating reactors. With complete declassification of the United States program on the eve of the 1958 Geneva conference, however, the doors were flung open for international cooperation. After Geneva not only British scientists but also Russians began to correspond informally with their counterparts in the United States.³⁵

Even after declassification any significant exchanges with scientists in the Soviet Union required extensive diplomatic negotiations. Experience had already shown that, without a written agreement setting forth specific details for visits and the exchange of information, the Russians were not likely to grant fully reciprocal concessions. Fortunately the framework for exchanges in the field of nuclear physics already existed. In January 1958 the United States signed a two-year agreement with the Soviet Union providing for a broad range of exchanges in cultural, technical, and educational fields. Section 9 of the agreement permitted the exchange of "scientists and specialists for delivering lectures and holding seminars on various problems of science and technology."³⁶

Isidor Rabi used the occasion of a meeting of a United Nations scientific advisory committee in Vienna in June 1959 to open discussion of a specific agreement with the Russians in the nuclear sciences. The Soviet delegate was Vasily S. Emelyanov, a metallurgist and government official already well known to Americans. Emelyanov, an intelligent and articulate man, chaired the Main Administration for the Utilization of Atomic Energy in the Soviet Union. He was responsible for all areas of the peaceful applications of nuclear energy; but he was subordinate to Soviet officials who directed the weapon and production activities, and he had no role in test-ban negotiations. Rabi and John Hall discussed with Emelyanov ways of reducing the tensions and suspicions that made the arrangement of scientific exchanges difficult. When Rabi suggested an exchange on nuclear power reactors, Emelyanov at once proposed a visit to the Soviet Union by McCone. Rabi reacted favorably, but he warned Emelyanov that the Americans were interested in visiting only large power stations, particularly those under construction, and not small experimental reactors. Emelyanov agreed to take up this issue with Chairman Khrushchev immediately upon

his return to Moscow. On fusion research, Emelyanov was more optimistic about the possibilities than was Rabi, who noted that several American fusion projects were located at sites of weapon research.³⁷

Before the McCone trip could be arranged, the Commission had to decide whether to permit Frol R. Kozlov, the first deputy premier of the Soviet Union, to visit Commission facilities during a visit to the United States in late June. With some hesitation the Commissioners agreed on the grounds that the visit would include facilities of low sensitivity: the nuclear ship *Savannah*, the Shippingport plant, and the Berkeley Radiation Laboratory. Another consideration was to ensure a warm Soviet reception for Vice-President Nixon, who was scheduled to arrive in Moscow in a few weeks.³⁸

Nixon's trip to the Soviet Union took on significance for the Commission when McCone arranged to have Rickover join the Vice-President's party. No more awed by Kremlin leaders than he was by American presidents and senators, Rickover brushed aside diplomatic amenities and brusquely stated his intention to conclude an agreement to exchange reactor technology before Nixon left Moscow. Much to the later dismay of Commission officials, Rickover claimed that he was authorized by the President to include all American reactors in the agreement, even the production reactors at Hanford and Savannah River and the aircraft propulsion project, but not naval propulsion systems. As one official wryly noted, Rickover was willing to give away everything on all reactors except those for which he was responsible. Kozlov found Rickover's proposal intriguing and suggested that he discuss the details with the appropriate Soviet officials, in this case Emelyanov.³⁹

By the time Rickover met with Emelyanov on August 2, he had ruffled more Soviet feathers. As the first American to visit the Soviet nuclear-powered icebreaker *Lenin*, Rickover had made a scene when Soviet officials tried to steer him away from specific details about the ship's reactor. Eventually the Russians gave in, but not before some of the press had picked up the incident. Rickover had also embarrassed his hosts by slipping away from his security escorts and spending several hours talking with private citizens without surveillance. McCone cabled Rickover a "well done" on the *Lenin* episode and urged him to gain access to nuclear power plants and "fully develop their views [on their] nuclear power program."⁴⁰

Emelyanov was no doubt on his guard when Rickover arrived, and he soon learned that reports of Rickover's abrasive personality were true. Rickover began the conversation by saying there had been lots of talk about peace and friendship, but now was the time to do something about it. He pulled out a list of Soviet reactor projects and tried to extract a commitment from Emelyanov on each one. Emelyanov gave tentative reactions to each proposal but refused to say anything about production reactors or aircraft

propulsion work in the Soviet Union. The meeting did not end on a congenial note.⁴¹

McCone had his first opportunity to meet with Emelyanov when Premier Khrushchev came to Washington in September 1959. With firm recommendations from the Commission staff that he proceed cautiously, McCone did not attempt to follow up Rickover's hard bargaining in Moscow, but rather accepted Emelyanov's suggestion that they consider first things first—namely, an exchange of visits by themselves. These visits might be followed by an exchange of information in selected fields and then possibly a joint project on thermonuclear reactors or accelerators.⁴²

By the time Emelyanov had returned to Washington after the western tour of Khrushchev's party McCone had had a chance to discuss his tactics with the President. Eisenhower readily accepted the idea of cooperation with the Russians on peaceful uses but stressed that the exchange should be used to bolster the sagging image of the International Atomic Energy Agency. McCone admitted that he was neither as enthusiastic about a trip to Russia as his staff nor as hopeful that it would produce useful information, but he thought he should probably be able to say that he had at least visited Russian installations. Eisenhower suggested that McCone "do a good deal of listening" when he next met with Emelyanov. Keep the British and Canadians informed, the President told McCone, and do what you can to support the international agency.⁴³

In a second meeting on September 25, McCone and Emelyanov quickly agreed on the types of facilities to be visited by each of them and on the kinds of information to be exchanged after the visits. The exchange was to cover eleven areas of the physical and biological sciences, including high-energy physics and fusion and power reactor development. McCone hoped that Khrushchev and Eisenhower would endorse the agreement the next day at Camp David, but other matters took precedence. The President later assured McCone that both leaders were aware of the proposal; Eisenhower seemed much more interested in Khrushchev's remark that the Russians had found the development of nuclear power far more difficult and expensive than they had anticipated and they were cutting back sharply on reactor projects. McCone wrote that the President "seemed to be telling me that I should take these views into consideration in connection with our budget."⁴⁴

After some uncertainty about the proper timing for his trip to the Soviet Union, McCone departed on October 8 with Commissioner John H. Williams, a high-energy physicist; Alvin Weinberg from Oak Ridge National Laboratory and Frank Pittman to cover reactor development; Lyman Spitzer from Princeton to cover fusion research; and Kenneth S. Pitzer, a chemist from the University of California, to cover metallurgy research and uranium mining and processing. Arriving at Tallinn, Estonia, the group

boarded the *Lenin* for a short cruise, visited two research institutes in Leningrad, and in Moscow saw the Russians' first research reactor, a fusion experiment, and several accelerators. At Dubna, outside Moscow, the group inspected five nuclear research facilities that housed several accelerators and other experimental devices. Then the group divided for separate visits to several nuclear power stations, a uranium mine, and a uranium reduction plant.⁴⁵

When McCone met with the President on October 27 to discuss plans for Emelyanov's visit, he had almost an hour to describe his Soviet adventure. McCone found the *Lenin* a far more impressive piece of engineering than Rickover had suggested. He thought the Russians' nuclear power program was considerably behind the United States', but he admitted that the Russians had cut back their work in this area. Soviet fusion research was good and closely followed the American course. Soviet scientists were well trained, competent, and well treated. McCone thought the Russians' level of effort in the peaceful technologies was roughly equal to that in the United States but not as far advanced in any area.⁴⁶

Emelyanov and eight distinguished Soviet scientists arrived in the United States on November 5, 1959, to tour nuclear facilities at eleven sites, mostly power reactors and national laboratories. By the time Emelyanov returned to Washington McCone had reviewed the draft exchange agreement with the Commission staff and had checked his proposed course of action once again with the President, who saw no reason to delay unless the exchange would actually hurt the United States. Impressed and gratified by the tour, Emelyanov engaged McCone in a wide-ranging and unusually frank discussion of their roles as agents of cooperation and understanding. He described to McCone how he had come to believe that Khrushchev, unlike Stalin, was sincerely dedicated to disarmament and peaceful co-existence. Emelyanov knew that McCone had his own problems with the politicians, but men in their positions had to expect such difficulties. "Everything," Emelyanov said, "depends on the two of us."⁴⁷

The McCone-Emelyanov memorandum provided that specialists in small groups would be permitted to visit designated facilities in the host country for ten to fifteen days for conferences and examination of equipment related to fusion research, power reactors, high-energy physics, neutron physics, and the structure of the nucleus. The two nations agreed to exchange abstracts of unclassified work on peaceful uses of atomic energy, including both formal and informal reports, all of which were to be made available to the International Atomic Energy Agency. Both sides were to explore the possibility of setting up joint projects to build fusion reactors and accelerators and to study other technical problems.⁴⁸

To top off Emelyanov's successful trip, the President invited him to the Oval Office for a brief visit after the formal signing of the memorandum on November 24. Eisenhower used the occasion to express his personal

interest in the future of nuclear power and his hope that, working within the international agency, the two nations could pool some of their resources to develop peaceful uses. Emelyanov replied that the Soviet Union was looking forward to the President's visit in April 1960; he hoped Eisenhower could see some nuclear facilities while there.⁴⁹

Arrangements for the first exchange visits proceeded slowly. During winter 1960 Emelyanov was scarcely ever in Moscow as he travelled with Khrushchev on several foreign trips. Not until late April did Emelyanov accept McCone's proposal to send five American scientists to the Soviet Union in May. Despite Khrushchev's outraged reaction to the U-2 spy plane incident a few days later and the cancellation of the long-planned summit meeting with Eisenhower, Emelyanov did not withdraw the invitation to a team of American physicists, who arrived in Moscow on May 12. Two weeks later, after a fruitful series of conferences at eight Soviet installations engaged in high-energy physics, the Americans were taken without prior notice to a meeting with Emelyanov. The high spirits of the Americans quickly faded as the bitter and discouraged official unburdened himself of a long list of resentments and complaints about American actions going back to 1956. The list included last-minute refusals by the American government to permit him to attend scientific conferences in the United States, Rickover's insulting remarks to prominent Soviet scientists at Shippingport, and provocative and persistent questions from American scientists as well as the press. The Americans did not seem to understand how such discourtesies could upset the tenuous status of the exchange program. Even more serious were the effects of the U-2 incident; it had confirmed the opinions of some Soviet officials who had long charged that the Americans could not be trusted and that Emelyanov had been naive and foolish in his quest for international cooperation.⁵⁰

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Emelyanov was in a friendly and cordial mood when he met privately with McCone in Vienna in September 1960. A Soviet fusion research team had visited five American laboratories in May and then in July a second pair of visits by an American fusion team and Soviet high-energy physicists had been accomplished, much to the satisfaction of all concerned. In Vienna McCone was able to resolve or postpone decisions on several issues that had first been raised in 1959. New difficulties with fast-breeder reactor experiments in both countries had caused the Russians to abandon their earlier insistence upon an exchange, which the Americans considered unfruitful, in this area. The Russians attending the high-energy physics conference in Rochester in August had been convinced that any decision to start work on a new accelerator in the 500-GeV range should be delayed for at least a year. Thus, Emelyanov gave up at least temporarily his hope expressed in spring 1959 that the two nations set up a joint project to build a new accelerator, probably near Vienna. The two leaders did agree that when such a joint project was established it would be a bilateral relation-

ship with representatives of the international agency participating only as observers. Emelyanov accepted McCone's suggestion that they consider a joint study of the disposal of radioactive waste. Toward the end of the meeting Emelyanov again gave vent to the frustrations he had expressed to the American physicists. Because the Americans commanded an unbreakable majority in the international agency, Emelyanov had been unable as the Soviet representative to accomplish most missions assigned to him in Moscow. He complained that he was badgered by his associates at home who repeatedly asked him what five years of cooperation had accomplished. Emelyanov said it was hard to find a convincing answer.⁵¹

536 McCone met Emelyanov one last time in New York on November 19. John F. Kennedy had just been elected President, and McCone did not yet know what his future would be. Emelyanov's position in the Soviet hierarchy was by no means secure, as McCone already knew. With little to discuss on the exchange program, the two veterans indulged in a sharp but friendly debate over the proposed test ban and disarmament. McCone took strong issue with Emelyanov's charge that he was opposed to the cessation of nuclear tests. He insisted that he favored cessation with reasonable controls against cheating, but McCone believed that the Russians had no interest in controls. When Emelyanov complained that the U-2 incident made it hard to believe that the Americans were serious about friendship with the Soviet Union, McCone replied that the trouble lay in the Soviet insistence upon secrecy; until the Soviet leaders created an open society, there was only a limited base for mutual trust. Even after five years of frustration, Emelyanov could not bring himself to abandon the hope that somehow international cooperation among scientists might lead to peace, but McCone was probably too much a realist to believe that goal was within reach.⁵²

CHAPTER 20

THE TEST BAN: A FADING HOPE

By the end of May 1958 President Eisenhower thought he had found a new path that might lead out of the nuclear nightmare. After months of fruitless sparring with the Russians and endless debate with his own advisers, the President had succeeded in extracting a commitment from the Soviet Union to participate in an international conference of scientists who would meet in Geneva on July 1. The purpose of the conference would be to examine the technical difficulties involved in policing a ban on the testing of nuclear weapons. The chances of success were indeed small, but the goal was more than worth the effort.

PREPARING FOR THE CONFERENCE

On the eve of the Geneva conference certain restrictive provisions of the Atomic Energy Act remained an impediment to a test-ban agreement. Unless Congress amended the act, allowing the United States to share nuclear weapon information with its allies, the United Kingdom was unwilling to forgo its own plans for testing nuclear weapons. Following the December 1957 NATO meetings, Eisenhower had promised to promote greater integration of nuclear forces within the Western alliance. The Commission had subsequently submitted the necessary amendment to Congress, where the proposal ran into stiff opposition from the Joint Committee.

The Joint Committee, always the cautious guardian of nuclear weapon information, was skeptical about the wisdom of sharing restricted data with the NATO allies. Concerned about the stability of European governments, the committee was worried that friendly governments might decide to pass along American nuclear weapon technology to others. Com-

mission and Defense Department officials tried to assure the committee that there was little danger of proliferation because the proposed amendments would restrict sharing of weapon information to countries, like the United Kingdom, that had advanced nuclear weapon programs. Strauss, however, whose relations with Senator Anderson continued to deteriorate, was no longer an effective spokesman for the Administration.

538 Ultimately, Dulles had to step into the breach to save the amendments. Unless the Atomic Energy Act was amended, he predicted, NATO would be weakened and NATO governments would either seek their own nuclear capability or take a neutral stance. Mindful of the proliferation danger, Dulles stressed the need for common defense planning, common training of nuclear equipped forces, shared naval nuclear reactors, and the exchange of information with allies that already have nuclear weapons. Dulles frankly asked the Joint Committee why the British should be "forced to follow the sterile course of reworking ground already covered by the United States and known to the Soviet Union." Then without mentioning a test ban, Dulles reiterated three times the linkage between the amendments and the disarmament negotiations. He concluded "that all our major planning, both in terms of disarmament, the limitation of nuclear testing, the limitation of the use of nuclear weapons, the building of NATO, all of those plans would be disastrously affected, in my opinion, without this legislation."¹

Congress amended the Atomic Energy Act of 1954 on June 30, and Eisenhower signed the legislation on July 2. Under the new amendment the President could authorize the Commission or the Department of Defense to transfer nonnuclear parts of atomic weapons and special nuclear materials for military applications to nations that had "made substantial progress in the development of atomic weapons."²

CONFERENCE OF EXPERTS, GENEVA

Throughout June, the American scientists prepared for the opening of the Geneva Conference of Experts to Study the Methods of Detecting Violations of a Possible Agreement on the Suspension of Nuclear Tests. At Killian's suggestion, Eisenhower had asked James B. Fisk, a member of the President's Science Advisory Committee and vice-president of Bell Laboratories, to lead the delegation. Other members of the delegation were Ernest O. Lawrence and Robert F. Bacher, former Commissioner, physics professor at the California Institute of Technology, and member of the Science Advisory Committee. Strauss had wanted to appoint Teller, but the outspoken scientist had been disqualified by his vigorous support of testing. None of the three members of the American delegation had been fierce partisans in

the disarmament debates, yet they represented a satisfactory balance of the contending parties. To balance the delegation even more, Bethe and Harold Brown, associate director of the Livermore laboratory, were appointed advisers. The British named Sir John Cockcroft and Sir William Penney; the French, Yves Rocard of the École normale supérieure de Paris; and the Canadians, Dr. Ormond Solandt, former chairman of Canada's Defense Research Board.³

When Dulles briefed Fisk, Lawrence, and Bacher on June 6, he emphasized the importance that he and the President attached to the Geneva conference of experts. He warned that the delegation's mission would be purely technical. The necessary political decisions would be made in Washington afterward, but sound technical recommendations were a prerequisite to a satisfactory political settlement. Dulles observed that the conference did not have to devise "a technically perfect system"; even an imperfect system would be satisfactory as long as violation created "an unacceptable risk" for the Soviet Union. Fisk, Bacher, and Lawrence were already aware of the need for more scientific data on detecting tests. Before their meeting with Dulles, they had asked Strauss whether the Commission could conduct another underground test in Nevada. Because *Rainier* had not provided sufficient information about detection, they wanted a larger shot. In what would prove a fateful decision for the future of testing, Strauss had promised to see what he could do.⁴

When the President's Science Advisory Committee met with Eisenhower on June 18, Fisk, Bacher, and Killian reviewed preparations for the Geneva conference of experts. Killian mentioned the potential difficulty of declassifying information for the meeting. Considering what the United States planned to accomplish in Geneva, Eisenhower hoped that the Commission would adopt a liberal policy on classification. Consequently, Strauss's special assistant, Navy Captain John H. Morse, Jr., armed with declassification authority, became the Commission's principal representative in the Western delegation.⁵

Almost simultaneously after arriving in Geneva, both the Americans and Russians voiced their expectations for the conference of experts. On June 24, the United States delegation outlined the technical factors it considered relevant to monitoring a nuclear test suspension. The Americans expected the discussions to include detection and analysis of nuclear tests at low and high altitude, undersea and underground, and on the earth's surface. The principal means of detection would be the analysis of nuclear debris and acoustic, electromagnetic, and seismic signals. For the United States, these four categories provided a natural agenda. The Soviets, however, wanted the Westerners to agree to a test ban a priori. Without such a commitment, the Soviets asked rhetorically, "what sense is there in general in convoking such a conference and what sense is there in sending to it

experts?" On the very eve of the conference the American delegation waited in Geneva at the United States consulate wondering whether the Russians would actually appear.⁶

The Geneva conference of experts convened on July 1, 1958, the day after Lewis Strauss left the Commission. Although John McCone, as chairman-designate, professed to have no fixed opinions on testing, his appointment would neither upset the Commission's policies nor provide solace to test-ban advocates. During McCone's confirmation hearings, Senator Anderson had tried to test McCone on the issue by observing that much of the Commission's rhetoric had conflicted with the diplomatic objectives of the Secretary of State. When pressed for his own views, McCone replied that he favored a test suspension with "adequate and proper safeguards." Beyond that, he had "made no commitment" and had "no irrevocable conviction" on the matter.⁷ Obviously, McCone was trying to buy time and improve relationships with Anderson and other Democrats on the Joint Committee. Meanwhile, Strauss, now on the State Department payroll as Dulles's special assistant for peaceful nuclear energy, continued to receive Morse's status reports from Geneva.

The Soviet delegation included two members of the Soviet Academy of Sciences: the Soviet Union's first Nobel laureate in physics and one of the nation's most distinguished nuclear scientists. The strategist of the Soviet delegation was one of the nation's most experienced negotiators. Former American diplomat Charles Thayer noted:

When the Soviet delegation stepped from its plane it was headed by a shaggy-haired little man with an unprepossessing manner and a crooked smile. You could have searched in vain for his name in every register of Soviet scientific institutions. No American scientist had ever read one of his papers or heard him address a scientific gathering. But he was well known to many American diplomats as one of the Kremlin's toughest negotiators . . . with the name of Simyon [Semyon] Tsarapkin.

The Americans would ultimately call him "Old Scratchy."⁸

At the outset, the Soviets introduced political as well as scientific and technical issues. Their strategy was to question whether there was any purpose in exploring technical questions without prior commitments from both sides to stop testing. Fisk, however, insisted that the United States delegation would address only the "extremely difficult technical and operational problems" in detection and identification of nuclear tests. "These are not purposeless discussions," Fisk argued, "but are directed to provide Governments with one of the necessary parts of the whole material required for a political decision on whether or not nuclear tests shall be suspended." Attempting to draw from the United States' experience with prohibition, Yevgeni K. Fedorov countered by pointing out how silly it would have been

for American police to discuss means of enforcing prohibition without an actual law on the statutes. Quickly Fisk responded that before deciding on prohibition the United States might well have determined whether or not it was enforceable. Although the Americans were worried that the Russians might walk out of the conference, Fedorov, seeing that Fisk would not yield to political pressure, ultimately backed off so that the conference could continue.⁹

THE GENEVA SYSTEM

Through July and into August the experts settled into the negotiations that created what came to be known as "the Geneva system." The Soviet delegates appeared much less concerned about details than did the Western delegates, and they were far more willing to hurry the discussions. When confronted with difficult technical problems, the Soviets expressed confidence that technical solutions could be found eventually if both sides would accept agreements in principle. Morse, who mistrusted the Russians, reported to Strauss that Fisk and Bacher had been swept away by the momentum of the discussions and become reluctant to press the Soviets with hard questions. Although both sides agreed that "further investigation" was necessary on detecting high-altitude and deep-underground tests, the Soviets carefully qualified their language so that no further tests were implied, while the Western representatives were equally careful to avoid committing to end testing completely.

The Geneva system was based on the assumption that nuclear explosions could be readily monitored through either radioactive debris (fallout) or seismic, acoustic, and electromagnetic waves. Detection of atmospheric testing had become relatively routine through sophisticated air sampling techniques. Acoustically, underwater testing would be difficult to conceal. High-altitude (outer space) and underground testing, however, were not so easily monitored. Prior to 1958 the United States had not conducted high-altitude tests. Because both the Americans and the Russians lacked experimental data for detecting high-altitude testing, discussions in this area were theoretical, and the Geneva system did not include specific techniques for detecting high-altitude tests.¹⁰

The greatest concern for both sides was detecting clandestine testing underground. On the basis of the data obtained from the *Rainier* shot and theoretical studies, Western scientists were confident that they could identify underground tests from seismic signals, provided a sufficient number of control posts were established. The conference of experts ultimately recommended a network of 160 to 170 land-based control posts and perhaps ten ships. About 110 posts would be located on continents, with the remainder established on oceanic islands. All posts would be equipped to

detect fallout and seismic, acoustic, and electromagnetic waves; those located near oceans would monitor hydroacoustic waves. Each post would be manned by about thirty persons. Offshore air sampling by aircraft would continue, and some provision for on-site inspection would be required. With the exception of high-altitude tests, the experts were confident that the proposed control system would detect most tests larger than one kiloton.¹¹

The report of the conference of experts left many issues open. The Geneva system did not specify the number of control posts to be located in the Soviet Union or the United States, nor did it settle who would operate the control posts. On the sensitive issue of on-site inspections, the West obtained an important agreement in principle, but the conference of experts defined neither the number nor the frequency of inspections that might be required. From the Western point of view, such details required "political" decisions beyond the mandate of the conference.

542 Killian spoke for many scientists in hailing the work of Fisk and the American delegation as a triumph, but some scholars later criticized the Administration for sending inexperienced scientists to negotiate with one of the Soviet's most seasoned and wily diplomats. Although Fisk and Bacher hardly matched Tsarapkin's diplomatic experience and skill, they succeeded in negotiating the basis for a technically feasible international monitoring system. If they failed to fill in details or define some terms, it was because many "details" involved sensitive political judgments as well as technical definition. The last month of discussions in Geneva was often dominated with just such political pulling and hauling. Fisk wrote Killian that the Russians repeatedly raised political issues concerning inspections and the organization of the control system. "We waste considerable time on such things," he reported, "but I refuse to be drawn in." In the end, the Geneva system would stand or fall on the operation and maintenance of control posts and the implementation of on-site inspections—both quintessentially political issues that the American scientists would leave for later discussions.¹²

SEEKING AN ALTERNATIVE TO TESTING

During summer 1958 the Commission, with the support of Livermore laboratory, made a last-ditch effort to save the testing program from a moratorium. Through Philip Farley at the State Department, the Commission received working papers drafted at the conference. The Commissioners worried that the conference delegates had been too optimistic about detecting underground or high-altitude tests, where very little experimental evidence existed. Most seriously, the Geneva negotiators seemed to have overlooked the possibility of "energy decoupling" in underground shots in order

to conceal the seismic evidence of a nuclear detonation. Seismic detection depended on the coupling of the underground explosion with the surrounding earth, which carried shock waves to monitoring seismographs. Decoupling involved firing a relatively small shot in a very large underground chamber, thus "muffling" the seismic waves sufficiently to escape or confuse detection by the control posts. Without on-site inspections of areas where violations were suspected, it would be difficult to differentiate certain tests from earthquakes. The Commission urged Farley to explore decoupling further before the United States agreed to any test ban.¹³

With the conference of experts obviously moving toward agreement, Libby and Teller personally asked McCone to appeal to the President and Dulles for a "test limitation." The ideal test limitation, according to Libby and Teller, would annually restrict atmospheric testing to one megaton of total fission yield per country. By limiting atmospheric testing, they hoped to halt the annual increase in worldwide fallout. As a contingency, Libby and Teller were also willing to limit testing to underground shots alone if that were the only alternative. They justified continued testing primarily on the need for the United States to develop small, "clean" defensive weapons.¹⁴

On August 7, at the height of the United States' involvement in the 1958 Lebanon crisis, Farley noted the State Department's objections to the Libby-Teller proposal. The proposal was unacceptable because it would retreat from the Administration's goal for outright suspension of tests. Not only would the efforts of the conference of experts become contradictory and illogical, but also under a test limitation the Soviet Union could continue to reap propaganda advantage with its own unilateral suspension while avoiding any commitment on production cutoff or on-site inspections. Furthermore, test limitation, difficult to enforce, would not inhibit the proliferation of nuclear weapons. Perhaps most important, according to the President's Science Advisory Committee, a test ban would freeze nuclear weapon development at a time when the United States retained important advantages in weapon technology.¹⁵

Although McCone supported the Libby-Teller proposal, he knew that any sort of test ban involved policy decisions beyond the Commission's authority. The Commission did have a role, however, in advising the President on the effects of a test ban on weapon development and production as they related to national defense requirements. McCone would do his best to convince the Administration that a test ban would seriously impair the Commission's ability to meet military requirements, but he was resigned to the fact that national policy on testing would be decided by the White House and the State Department. In fact, McCone confided to Strauss that he thought the President had already made up his mind.¹⁶

McCone was too pessimistic in assessing the Commission's ultimate role in the test-ban debate, but he realized that the Commission was virtu-

ally alone in advocating test limitation rather than suspension. Certainly he did not have the support of the "committee of principals," a group that usually included the Secretaries of State and Defense or their deputies, Killian, Allen Dulles, the director of the Central Intelligence Agency, and himself. When the committee met on August 8, Secretary Dulles announced that he was withdrawing his initial endorsement of the Libby-Teller proposal. Regretfully, Dulles explained that the United States could not make decisions on testing unilaterally without alienating its allies. Deputy Secretary of Defense Donald A. Quarles, who also backed away from the Libby-Teller proposal, now suggested that the United States suspend testing for two years, contingent on agreement by the conference of experts to establish a monitoring system. In Quarles's plan, the United States would test underground only devices smaller than the monitoring system could reliably detect. A permanent test ban would wait until the monitoring system had proven effective and on-site inspection for a production cutoff had been established. A subsequent meeting of the committee of principals failed to produce a consensus among the Departments of State and Defense and the Commission.¹⁷

McCone, Teller, and Bradbury were able to appeal directly to Eisenhower on August 12 when they briefed the President on the success of the *Hardtack* test series. Armed with sketches of the *Hardtack* devices, Teller emphasized the significance of a very small weapon that had been tested. He reported that *Hardtack* had improved weapons "by a factor two to five over the previously existing models." In the next year or two, Teller expected a similar rate of progress. Eisenhower admitted that he favored continued underground testing, but he observed that world opinion against testing could be even more powerful than thermonuclear weapons.¹⁸

The committee of principals met with Eisenhower on August 18 to discuss changes in the United States' policy on testing. Acting Secretary of State Christian A. Herter proposed separating the testing issue from the London disarmament proposals by suspending nuclear weapon testing for at least a year pending monitoring and inspection negotiations. Gordon Gray, the President's national security adviser, interjected that neither the Department of Defense, including the Joint Chiefs of Staff, nor the Commission had concurred with the State Department's proposals. Both McCone and Quarles were holding out for contained underground tests on the grounds that the political advantages of a test suspension did not outweigh the military disadvantages. Eisenhower recalled that Isidor I. Rabi, chairman of the general advisory committee, had claimed that Americans would benefit from a freeze because the United States was technically ahead of the Soviet Union, an opinion that Killian said the Science Advisory Committee shared. Eisenhower was sympathetic to making exceptions for *Plow-share* tests, but he did not believe the Russians would agree. For the rec-

ord, McCone voiced the Commission's unanimous opposition to cessation of tests. Acknowledging the Commission's fears, Eisenhower doubted whether cessation would cause any key personnel to leave the national laboratories. In the end, Eisenhower accepted the State Department's proposal with a few changes of his own.¹⁹

The following day McCone assured Eisenhower that the Commission would accept his decision on testing. McCone expressed his own sympathy for the President's desire significantly to advance disarmament after five and a half years of frustration. Still, McCone hoped that some exception might be made for fully contained underground *Plowshare* explosions such as those that might extract oil from underground formations. McCone was willing even to subject these shots to United Nations agreement and inspection. Wanting to accommodate the Commission if possible, Eisenhower agreed to support the *Plowshare* exception provided it did not sabotage an agreement to suspend weapon tests.²⁰

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STRAUSS'S APPEAL ON TESTING

Even as he prepared to end nuclear testing, Eisenhower kept his door open for last-minute arguments from both advocates and opponents of testing. Shortly after discussions with McCone on *Plowshare* testing for peaceful uses, Herter prevailed upon Eisenhower to reverse signals again and disallow underground peaceful shots unless the Russians specifically agreed to them.²¹ Angry and discouraged, McCone reported to Strauss that his colleagues at the Commission were so disgruntled that they were threatening to resign. Could Strauss put on his "bullet-proof vest," McCone asked, and go to see the President?

Strauss lunched with Libby to learn that, while the Commissioners were deeply embarrassed and demoralized, Libby was certainly not thinking of resigning. Next Strauss went to see General Andrew J. Goodpaster, staff secretary to the President, to find out just where matters stood. While talking to Goodpaster, Strauss was summoned by the President, who had heard that he was in the White House. Eisenhower was obviously upset by the failure of the committee of principals to achieve consensus on the testing question. Yet with Dulles's fixation on the issue, the President explained, the matter had gone too far to reverse. Briefly, Eisenhower seemed sympathetic to the Commission, although he again discounted the impact of the moratorium on the weapon laboratories. The risk, Strauss countered, was that the very best scientists would leave. Strauss also argued that under a test moratorium the development of peaceful nuclear explosives would be impossible.

Eisenhower interrupted the conversation to call Press Secretary

James Hagerty for a copy of the forthcoming presidential announcement. Strauss admitted that the statement was not as damaging as McCone had predicted, but he hazarded the observation that the statement surrendered to the views of Stevenson and Stassen. Abruptly, Eisenhower dropped his conciliatory veil. He told Strauss that the Commission's alternatives led nowhere but to an indefinite arms race; at least Dulles's position might be a step toward general disarmament.

546 The President and his atomic energy adviser now stood face to face over the fundamental moral question that divided them. Political imperatives, diplomatic pressures, military advantages, laboratory stability, escalating budgets, and peaceful uses were all important in deciding the testing issue. But most important for both Eisenhower and Strauss was the moral question. For Eisenhower, the test moratorium represented a major milestone on the road toward the international control of atomic energy first mapped in his *Atoms-for-Peace* speech in December 1953. Perhaps for the first time, Strauss saw the depth of Eisenhower's moral commitment to a nuclear test ban. Strauss conceded that the President's course was correct if the West could live in peace with communism. In contrast, Strauss regarded communism as he did sin—there could be no compromise with it. Dolefully, Strauss observed that the arms race between good and evil was centuries old, with no end in sight. As he left Eisenhower, Strauss realized that their ethical discussion had brought him to the brink of a "permanent fundamental disagreement" with the President.²²

THE AMERICAN MORATORIUM

On August 22, the day after the conference of experts adjourned in Geneva, Eisenhower announced that on October 31, 1958, the United States would suspend nuclear weapon testing indefinitely, provided the nuclear powers could establish an effective inspection system and make substantial progress on arms control. He also made good on his assurances to McCone and Strauss by calling for an agreement on "detonations for peaceful purposes, as distinct from weapons tests."²³

Although momentous, the President's announcement that the United States would suspend nuclear testing was both brief and general. He offered no indication that the United States had made a major change in its disarmament policy or had broken the linkage between nuclear weapons and disarmament established in the 1957 London disarmament proposals. At the President's news conference on August 27 most questions went to other issues. Only James Reston inquired about the Geneva conference and disarmament, specifically asking whether the United States had changed its policy. Eisenhower "muddled" through his reply by stating that the "principle" of the policy had not been abandoned at all. Insisting that the United

States had not changed its "general program or plan," he described the moratorium as a "step" along the route of disarmament negotiations.²⁴

The President's evasive reply did not reveal his deep personal commitment to the test ban, and this was probably intentional. First, he was no doubt sensitive to the raw nerves the issue had exposed within the Administration and the Joint Committee and among laboratory scientists. McCone did not even brief the Joint Committee on the Administration's intentions until August 21 when it was too late to change the President's action. Having achieved his long-sought goal over the vigorous protests of many in the defense establishment, Eisenhower avoided salting wounds when he was uncertain that a permanent test ban could be negotiated. Second, Eisenhower had changed NATO policy almost unilaterally. None too happily, the British had simultaneously endorsed the report of the conference of experts and pledged to join the test moratorium.²⁵ The French, who would not be a party to the test-ban negotiations, remained silent after Foreign Minister Maurice Couve de Murville repeated French opposition to a test ban to Eisenhower on August 21. No other NATO ally had contributed significantly to the discussions. Furthermore, Eisenhower was not ready to face squarely the problem of Communist China. That nation could hardly be ignored if the nuclear powers established a worldwide network of control and monitoring stations, but China could not be included in negotiations without at least tacit diplomatic recognition. Finally, the President's vagueness assured him maximum flexibility in future negotiations and kept public expectations from rising too high.

REACTIONS TO THE MORATORIUM

Certainly Eisenhower's caution was warranted by the Soviet Union's initial response to the Western offers to suspend testing. In an interview in *Pravda*, Khrushchev ridiculed the United States and Britain for placing "far-fetched" conditions on their proposals. According to Khrushchev a one-year moratorium would be "completely meaningless." Given Eisenhower's linkage of the test moratorium to verification systems and disarmament, Khrushchev wondered how it was "possible to lend credence to the statements of the United States and United Kingdom Governments concerning their alleged desire to discontinue tests?" Yet, in spite of his scorn, Khrushchev agreed to join negotiations in Geneva on October 31.²⁶

When the United Nations General Assembly met again in September 1958, the Soviets proposed the immediate suspension of tests without inspections. The Soviet move was followed by an Indian resolution that in substance matched the Soviet proposal by calling for an indefinite suspension of tests prior to further negotiations at Geneva. Surprised, the Western powers offered a counterresolution urging the suspension of tests under

effective international control. Although the Indian resolution with fourteen sponsors had the support of most African and Asian delegations, it was defeated in the General Assembly, as was the Soviet resolution. Following the adoption of the seventeen-nation Western proposal, India and Yugoslavia successfully moved to enlarge the disarmament commission to include all members of the United Nations General Assembly.²⁷

Demands at the United Nations for an immediate end to testing prior to Geneva talks were not without some foundation. Eisenhower and Macmillan had no sooner announced their intentions to suspend tests than the two Western powers, later joined by the Soviet Union, rushed to complete as many tests as possible before the October 31 deadline. The United Kingdom launched its Christmas Island series on August 22, the day of the Eisenhower-Macmillan announcements. Although planned since spring, *Hardtack II* was not approved by Eisenhower until August 29. During the next two months at the Nevada Test Site the Commission conducted thirty-seven tests, concentrating on small devices and underground shots. Teller, especially, was anxious to obtain more data on the detection and monitoring of underground tests. As late as October 29, Eisenhower approved the final tests in Nevada providing they were conducted "prior to October 31."²⁸

The Soviets were not as fastidious about completing their Siberian tests by the October 31 deadline. The last round of Soviet tests began on September 30 and, in contrast to *Hardtack II*, included several atmospheric shots in the megaton range. The tests were the most extensive ever conducted in the Soviet Union. They were so dirty, Libby later reported, that the total off-site fallout from Soviet tests in October 1958 equaled the total produced from United States tests in the preceding four years. Because the Russians had broken their self-imposed suspension, General Alfred D. Starbird, the Commission's director of military application, doubted that they could be trusted to maintain an indefinite, unsupervised moratorium. Starbird feared the Soviet Union would drag out negotiations in order to halt the United States testing program for an extended period of time. Consequently he urged the Commission to maintain readiness to resume tests within ninety days should the Russians break the moratorium.²⁹

Even as the diplomats gathered in Geneva to resume disarmament negotiations, the Russians tested on November 1 and 3. Americans worried that, if the Soviet Union continued testing, the Geneva talks would collapse before they ever started. On November 7, Eisenhower issued the Russians a gentle warning. If the Soviet Union continued testing despite the United Nations resolution, the United States would be relieved of any obligation to halt its own testing program. But the President did not threaten to break off negotiations. When the Commission detected no further Soviet tests, the nuclear weapon test moratorium finally became effective. Eisenhower had achieved one of the cherished goals of his presidency.³⁰

HARDTACK AND THE TEST BAN

The apparent success of the Geneva conference of experts during summer 1958 led some prominent American scientists to suggest publicly that, by concentrating entirely on technical issues and excluding politics, the scientists in Geneva had broken down barriers that had stymied efforts to reduce the threat of nuclear war for more than a decade. According to Eugene Rabinowitch in the *Bulletin of the Atomic Scientists*, the conference had

confirmed the belief of scientists that once an international problem has been formulated in scientifically significant terms, scientists from all countries, despite their different political or ideological backgrounds, will be able to find a common language and arrive at an agreed solution.³¹

Within weeks after President Eisenhower announced the one-year moratorium on American testing on October 31, 1958, however, the heady optimism generated by the Geneva meeting began to dissipate. Early in December, Killian informed McCone that preliminary analysis of seismic data from the recent *Hardtack* tests in Nevada suggested that the assumptions used in Geneva to design a worldwide network to detect underground tests no longer seemed valid. The Geneva experts had relied upon data from the United States' first underground test, *Rainier*, in September 1957. On the basis of *Rainier*, the experts had devised a network they believed would detect very small explosions; more recent *Hardtack* data indicated that the network would probably not be as effective and that it would be much more difficult than previously thought to distinguish between a nuclear explosion and a natural earthquake.³²

Hardtack had also undermined the experts' assumptions in another respect. During the summer the experts had concluded that at least for the immediate future the difficulties and expense of conducting nuclear tests at high altitudes made it unnecessary to establish a detection system for such tests. What the experts did not know, however, was that the United States had recently conducted three high-altitude tests during the Pacific phase of *Hardtack*.³³

The instinctive reaction within the Administration was to attack the new difficulties with scientific studies. Killian with McCone's support immediately assembled a group of seismologists to examine the *Hardtack* data in light of the Geneva system. When the group concluded that the Geneva system indeed would have to be revised, Killian appointed two panels of eminent scientists to study the questions raised. The first panel, assigned to find ways to improve the seismic detection capabilities of the Geneva system, was directed by physicist Lloyd V. Berkner, president of Associated Universities Incorporated, which operated Brookhaven National Labo-

ratory. The second panel, to investigate the feasibility of detecting high-altitude detonations, worked under the leadership of Wolfgang Panofsky, who was already well known to the Administration as the promoter of the Stanford linear accelerator. Thus, Killian and the Administration continued to rely upon what might be called "establishment" scientists to resolve policy issues related not only to international cooperation in nuclear research and development but also to the proposed test ban and disarmament. The group included scientists in the national laboratories, in universities with Commission contracts, and others who were convinced that the Geneva conference had opened an unprecedented opportunity to halt the nuclear arms race.³⁴

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As McCone soon discovered, however, others in the scientific community were sharply critical of the Geneva system and those who had negotiated it. Captain Morse charged that the *Hardtack* findings cast "doubt upon all 'scientific' conclusions of the experts" and confirmed Edward Teller's and his own predictions that these conclusions would prove invalid. Morse urged McCone to inform the Joint Committee at once that the technical basis for the test-ban agreement had been undermined. He also suggested that David M. Griggs, a seismologist at the University of California at Los Angeles, be appointed to the Panofsky panel in order to provide better balance. As Morse explained it, four of the six seismologists on the panel had been involved in the Geneva meetings. "While honest men, they may have an unconscious reluctance to admit that they were wrong." Morse reminded the chairman that Griggs had joined Teller three years earlier in proposing an underground test, a proposal that resulted in the *Rainier* shot.³⁵

Morse might have added, as Teller did the following day in a meeting with Strauss, that "the group of Rabi, Bethe and Bacher, who are the prime movers of test suspension, are the same individuals who bitterly opposed the H-bomb program and that their advice, whether sincere or innocent, has been invariably wrong." Teller told Strauss that he was ready to make a public statement denouncing the Geneva system even if it forced his resignation as director of the Livermore laboratory. Strauss suggested instead that Teller take his concerns to McCone or try to write a letter to the President. Morse saw little hope of accomplishing anything through the Commission. As he saw it, McCone "had apparently given up the fight," the other Commissioners were "confused or not informed," and the many staff members who agreed with him were willing to leave foreign policy issues concerning nuclear weapons to the State Department.³⁶

McCone did not miss the implications of the dispute. The emotional reaction of Morse, Teller, and others showed that the deep fissures in the scientific community created by the H-bomb controversy and the Oppenheimer case still existed. McCone would do well to defuse the argument before it became a public issue. He was too experienced to be swept off

his feet by Teller's emotional appeals; yet he could see the incident as another example of how idealism could warp the judgment even of scientists. Killian, looking back on the episode years later, absolved the Geneva scientists and put the blame for the dispute on the Science Advisory Committee and himself for not "making clear the evolving nature of science and the inevitability of technical surprises" when the *Hardtack* data were presented. "It was quite natural that new seismic data would become available as underground tests proceeded, and it was quite natural that science would respond to the new data with new solutions."³⁷

At the time, however, some scientists did not fully appreciate that the test-ban negotiations with the Russians involved political as well as technical issues and that the two could not be separated. Ambassador Wadsworth and others in the American delegation who met with the Russians in Geneva when the Conference on the Discontinuance of Nuclear Weapons Tests reconvened on October 31 soon became aware of that fact. The informal discussions that had proved helpful in reaching agreement with the Russians during the summer no longer seemed possible as Tsarapkin and the Soviet delegation took a legalistic, political approach to all issues. The American delegates had come home from Geneva in August believing that they had won a monumental victory in convincing the Russians to acknowledge the need for on-site inspection of suspected nuclear test sites. Now, by insisting that any member of the control commission could veto a proposed inspection, the Russians revealed that their true position was now what one historian has described as "self-inspection plus the veto."³⁸

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BREAKING THE DISARMAMENT LINK

Faced with the inflexible stance of the Russians in the Geneva negotiations, the Administration began to consider ways of modifying the United States' position in order to improve chances of reaching an agreement with the Soviet Union. Senator Albert Gore, a member of the Joint Committee, had raised that possibility in a confidential memorandum to the President in November 1958. Fearing that the United States was "negotiating toward an unattainable goal," Gore urged Eisenhower to break the nuclear stalemate by announcing an "unconditional and unilateral cessation of all nuclear tests" in the atmosphere for three years and inviting other nations to join in negotiating a permanent ban on atmospheric tests. The Administration generally agreed that Gore's proposal conceded too much to the Russians, but it thought Prime Minister Macmillan's plan more plausible. Macmillan proposed that the two nations should "drop our condition that an agreement to stop nuclear tests should be subject to satisfactory progress towards real disarmament." Dulles liked Macmillan's suggestion because he believed

that such a move might prevent the Geneva talks from collapsing. When McCone supported Dulles, Eisenhower wrote Macmillan that the United States would drop the condition "which the Russians may use as a screen to evade accepting responsibility for failure in the negotiations or to evade facing up to the control problem." In making the decision on January 12, Eisenhower expressed the hope that it would not be publicized, but Ambassador Wadsworth announced the decision eight days later.³⁹

552 It was perhaps surprising to some members of the Administration that McCone acceded in this concession to the Russians. During his first six months as chairman he had closely followed the hard line laid down by Strauss. McCone, however, was motivated not so much by anticommunist dogmatism, as Strauss had been, but rather by a determination to drive hard bargains with the Russians in the interests of the United States. His willingness to concede the disarmament link was but the first step in an effort to reduce nuclear weapon policy into its constituent parts. Before Macmillan's letter arrived, McCone was already exploring within the Commission the wisdom of initially concentrating the Geneva negotiations on an atmospheric test ban while leaving high-altitude and underground testing for later resolution. Unlike Gore and others, McCone was interested not so much in improving the chances for some kind of agreement, however modest, but rather in sustaining the principle long held by the Commission that control was the essential feature in any test-ban agreement and that "only those tests which are detectable and identifiable are to be prohibited by treaty." The Commissioners reasoned that atmospheric tests could be banned at once because a capability of detecting all tests of this type already existed. The Commission wanted to exclude high-altitude and underground tests from negotiation until a reliable detection system had been designed and accepted by the Russians. Another argument for exclusion was that only atmospheric tests contributed to radioactive fallout.⁴⁰

THE ATMOSPHERIC TEST BAN

McCone continued to pursue his idea of concentrating Geneva negotiations on atmospheric testing. Although he found both Dulles and Under Secretary Herter sympathetic to his aims, there were objections to the proposal. Killian feared that it would leave the impression that the United States was conceding that fallout from atmospheric tests was dangerous and that the Commission was trying to find a loophole that would permit the laboratories to undertake high-altitude and underground tests. In fact, it became clear during these discussions that McCone proposed to begin a series of underground tests to develop more reliable data on detection capabilities. When Killian objected that the Berkner panel had found ways of substantially upgrading the Geneva system, McCone pointed out that the panel's sugges-

tions were all theoretical; only extensive testing would show whether they were practical. Despite McCone's personal appeal to Dulles, the State Department rejected the proposal. Herter wrote McCone that he appreciated the chairman's concerns about an adequate detection system, but the department had concluded that there was an overriding need "to maintain pressure on the Soviet Union" on the key issues of the organization and functioning of the international control commission. "So long as the Soviets maintain their demands for a veto and for staffing of control posts in the Soviet Union with their own nationals, no technical control system, whatever its capabilities, could be effective."⁴¹

Over the next several weeks, however, new developments revived an interest in McCone's proposal. Philip Farley reported that the proceedings in Geneva were deadlocked over the veto. The situation was so discouraging that the department was giving some thought to seeking a recess in the conference and finding a fall-back position so that the Russians could not blame the United States for ending the talks. McCone's proposal was an obvious candidate for a new American strategy. The matter took on some urgency when Prime Minister Macmillan announced plans to meet Khrushchev in Moscow before coming to Washington. C. Douglas Dillon, Under Secretary of State for economic affairs, told McCone on February 12 that the department would keep the Geneva talks "on dead center" until Macmillan returned from Moscow.⁴²

TECHNICAL ASSESSMENTS

By mid-March the Berkner and Panofsky panels had completed their reports, which were promptly circulated as classified documents within the Administration. The State Department released a summary of the Berkner report containing all the essential information. From the *Hardtack* data the panel concluded that the Geneva system for distinguishing nuclear explosions from earthquakes was less effective than had been estimated and that there were about twice as many natural earthquakes equivalent to an underground explosion of a given yield than had earlier been estimated; these discoveries meant that the number of earthquakes indistinguishable from underground nuclear explosions by seismic means alone would substantially increase. With improved equipment and techniques the panel thought that the net of 180 seismic stations proposed in the Geneva system would acquire the capability to detect nuclear explosions at even lower yields without improvements. The Berkner panel stressed the very limited nature of the data on which the study was based and the need to support a vigorous research program in seismology. In a second report the panel described the kinds of research that would be useful.⁴³

Perhaps of greatest interest to the Administration was a third report

from the Berkner panel on concealing an underground test by decoupling. Albert L. Latter of the Rand Corporation prepared the study that was not released as an unclassified document until late 1959. In a similar study the Panofsky panel provided information on conducting tests in outer space, detectable only by satellites, and concluded that no nation was likely to be capable of using this method in the near future.⁴⁴

A NEW STRATEGY FOR GENEVA

554 When Macmillan arrived in Washington in late March 1959, he reported that Khrushchev considered the American and British proposal for an inspection system nothing more than "a military espionage plan." Tsarapkin had already complained at Geneva that Western proposals to upgrade the Geneva system in order to overcome the deficiencies revealed by *Hardtack* would make hundreds of seismic events subject to inspection in the Soviet Union each year. In response, Macmillan had suggested a limited number of on-site inspections, but he still wondered whether the *Hardtack* data had not rendered the Geneva system impracticable. Killian, as he had on other occasions, contended that the situation was not as bad as Macmillan believed and that the Berkner panel had come up with effective technical improvements. McCone was pleased that Eisenhower raised the question of limiting negotiations to an atmospheric test ban, which could be effectively policed, while underground testing continued in order to develop an effective detection system in that medium. There was general agreement that such a move would meet two of the original aims of the Geneva conference: to stop fallout and to limit weapon development; but it would not meet the third, to discourage weapon research by other countries. McCone noted that the President was emphatic that the West not enter into any kind of test ban that could not be reliably policed. After the meeting on March 22, he wrote: "I feel that the AEC's position is *now* pretty well recognized as the proper one by everyone concerned."⁴⁵

With the Geneva talks resuming on April 13, 1959, the Administration needed to establish its strategy quickly and preferably in consonance with the British. The atmospheric test ban was a prime subject for discussion by the principals on March 26. Herter preferred to use it only as a fall-back position and then only after another recess. Killian thought that the Berkner and Latter reports had introduced new complications and made an atmospheric test ban alone look more like the right approach. In the end, Herter, Killian, and McCone all agreed that the best course would be to propose continuing negotiations toward ending all tests along with an offer to stop atmospheric tests as the first part of the package.⁴⁶

Herter's prudent approach did not entirely satisfy the President, who was determined to give "a note of hope" to the talks. "We cannot achieve

this," Eisenhower cabled Macmillan, "merely by resuming interminable wranglings over the veto and the composition of inspection teams." The West should make clear, the President said, that important differences in approach should not be a bar to putting into effect those indisputable elements of a control system. He included a draft of a letter to Khrushchev proposing an atmospheric test ban as the first step. A few days later the President sent the same letter to Khrushchev.⁴⁷

Ten days later Khrushchev rejected Eisenhower's proposal. A ban on atmospheric tests alone would mislead the public because tests would still continue at high altitudes and underground. Without mentioning the veto, Khrushchev pointed to the number of inspections as the chief stumbling block to agreement. He referred to his earlier discussions with Macmillan of the feasibility of setting a limit on the number of inspections in any one year. Thus, Khrushchev established the quota as the principal issue in the next round of Geneva negotiations.⁴⁸

THE QUOTA

Khrushchev's reply to Eisenhower opened the possibility that the Soviet Union might yield on the veto if some agreement could be reached on a quota of inspections to be permitted by each party in the course of a year. The possibility of a Soviet concession was heartening, but it also had its dangers, as McCone pointed out when he met on May 5, 1959, with the President and the principals. McCone reminded the group that a quota would compromise the long-held American position that any test ban had to be verifiable by an effective detection system. In light of the *Hardtack* data and the Latter report, only a ban on atmospheric tests as a first step would be consistent with that policy. The tenor of the group, however, was that some change was inevitable. The President volunteered that growing public concern over the arms race and fear of continuing fallout, especially from Soviet weapon tests, would eventually force the Administration to abandon atmospheric testing unilaterally. His reference to fallout was no doubt sparked by the announcement that the Joint Committee on Atomic Energy was beginning that same day a series of open hearings on the subject. As the principals' discussion continued, even McCone admitted that public opinion would probably force the United States to give up atmospheric testing. Thus the objective, as the President put it, was to reach an agreement with the Soviet Union that was more favorable to the United States than a de facto unilateral ban without any Soviet commitment to an inspection system. The crux of the matter then became the number of inspections allowed annually under the quota.⁴⁹

The Joint Committee hearings amply justified the principals' conclusion that fallout had become a controlling factor in test-ban policy. The four

days of testimony, but even more the thousands of pages of technical documents included in the printed record, showed clearly that the hazards of fallout had international dimensions. Scientists testifying at the hearings still considered strontium-90 and cesium-137 the greatest hazards of worldwide fallout (as distinguished from fallout near test sites). But several short-lived isotopes—such as strontium-89, iodine-131, barium-140, and zirconium-95—were also cited as potentially hazardous. The rate of deposition of strontium-90 had increased in spring 1959 in the northern hemisphere. Likewise, the content of strontium-90 and cesium-137 in food had risen since 1957, even more rapidly than the total fallout, suggesting that under certain conditions strontium-90 was being taken up directly by humans from food without going through the soil cycle. On the subject of biological effects of radiation, evidence was presented suggesting that the rate of dose might have some influence on the magnitude of genetic defects, but the biological significance of low levels of radiation was still unknown. No agreement was reached on whether or not there was a threshold of exposure below which there were no somatic effects such as cancer and leukemia.⁵⁰

556 The thorny question of the quota number was not easily resolved. On June 17 the principals gave some consideration to specifying a percentage of suspicious events as the criterion, but opinion quickly reverted to the idea of a quota, particularly if each side had the right to choose which events it wished to inspect. As Allen Dulles pointed out, the use of intelligence data would help to assure that the most important incidents were inspected. Killian found the idea of "a quota with choice" promising and felt confident that one hundred inspections annually under that system would give a high probability of catching any violation, fifty inspections would provide a questionable capability, and twenty-five would be unacceptable. McCone was inclined to agree, but the question of arriving at a precise number remained. For that determination the principals turned to an ad hoc committee of scientists under Robert Bacher.⁵¹

Events during the following three weeks did not clarify the quota issue. On a trip to Geneva McCone found that the Soviet delegation had succeeded in diverting the negotiations into petty details of the inspection system. In informal meetings the Russians insisted that they would not discuss quota numbers until agreement had been reached on the quota system. When pressed, Tsarapkin had indicated that the Soviets would accept a quota of no more than fifteen with no reference to technical capability of the inspection system. Under such an agreement, McCone guessed that public opinion would force the United States to accept an inadequate number, something like twenty-five or less. Tsarapkin, according to McCone, had no intention of giving up the veto in any respect, derided the conclusions of the Berkner panel, and was obviously pressing for a complete test ban. When the Bacher panel reported on July 9, the feasibility of the quota became even more uncertain. Now even Killian concluded that

the only safe policy for the United States was to accept an atmospheric test ban alone while further research was pursued. The Administration seemed to be reverting to the conservative position McCone first voiced in early 1959.⁵²

PRESSURES TO RESUME TESTING

As summer 1959 dragged on with no perceptible progress in the Geneva talks, pressures began to build within the Administration for resumed testing. During the moratorium the Commission's laboratories had accumulated various requirements for tests. They also needed to develop warheads for new types of missiles, to proof-test new weapons entering the stockpile, and to gather more information on weapon effects.⁵³

Efforts by the Commission and the Department of Defense to obtain the President's approval for the resumption of testing, if only underground, received a setback when George B. Kistiakowsky replaced Killian as the President's science adviser in July 1959. The new science adviser was determined to take some fresh issues to the Geneva talks and to halt McCone's efforts, as he saw them, to undermine the test ban. He did succeed in the latter instance, when he arranged the appointment of a special panel under James W. McRae, a vice-president of Western Electric, to examine the need for weapon tests. The McRae panel promptly concluded that tests were not necessary in the immediate future, except for one minor category.⁵⁴

In the meantime, both the Department of Defense and the Commission had to live with the fact that the voluntary moratorium was denying them the full potential of the nuclear stockpile. Just as worrisome to both agencies was the possibility that by the end of the year the President might once again extend the voluntary moratorium. In an insistent plea to McCone that bordered on insubordination, Starbird urged the Commission to make definite plans to resume testing soon after the first of the year and to convince the President to announce this decision promptly. With little effect McCone complained to the President that continually extending the moratorium would give the Soviet Union exactly what it wanted: an unpoliced ban of all nuclear tests.⁵⁵

Eisenhower, however, was not yet willing to make any public statement that would damage the chances of negotiating a test ban. When the Geneva talks resumed on October 28 after the August recess, Ambassador Wadsworth urged the Soviet delegates to participate in technical discussions of *Hardtack* data and the Latter report. American hopes rose when the Russians finally agreed to discuss the data after ten months of delay. A panel of outstanding scientists under the leadership of James Fisk went to Geneva late in November. But it soon became apparent that the Soviet

Union did not intend to discuss the issues. Instead the Soviet scientists, obviously under strict political instructions, raised spurious technical objections about the American data and, when the conference broke up in December, impugned the integrity and competence of the American delegation. Outraged by the Soviets' behavior, Eisenhower directed the State Department to publish Fisk's refutation of the Soviet charges and instructed Wadsworth to admonish the Soviet delegation when the test-ban conference reconvened in January.⁵⁶

TEST-BAN STRATEGY FOR 1960

During Christmas week, 1959, McCone joined the principals for a trip to Augusta, Georgia, to discuss test-ban policy with the President. The primary purpose was to consider a response to the Soviet attack on the Fisk working group, but both McCone and Gates hoped to persuade Eisenhower not to extend the moratorium, which was due to expire in two days. Eisenhower, as usual, was reluctant to issue a formal policy statement. He preferred to wait until some inquiry made a statement necessary and then to have it come from the State Department. After much discussion, however, he approved a rather oblique statement, which the State Department released later that day. In it the President deplored the actions of the Soviet delegation at the Geneva technical conference, but he assured the world that "we will resume negotiations in a continuing spirit of seeking to reach a safeguarded agreement. In the meantime, the voluntary moratorium on testing will expire on December 31." The United States was now free to resume testing but would not do so without announcing its intention in advance.⁵⁷

The principals' major concern in January 1960 was the proposal by Kistiakowsky and members of the President's Science Advisory Committee to come up with a fresh approach for the Geneva talks. The heart of the proposal was a new version of the old threshold idea. One idea considered in summer 1959 was to allay the Russians' concerns over a large number of inspections of seismic events by establishing a threshold in terms of kiloton yield, below which no inspections would be required. The new idea was to define the threshold in terms of seismic signal rather than yield. This change, which Kistiakowsky enthusiastically endorsed, offered the possibility of effective monitoring with about ten on-site inspections per year. The principals thought that a threshold of 4.75 on the Richter scale was reasonable, but the group recognized the possible need to adjust that figure in light of American interests. Too high a threshold might remove the justification for any seismic stations in the Soviet Union; too low a threshold might impair weapon development in the United States. McCone was in-

clined to accept the 4.75 threshold, but he wanted to explore its potential impact on American testing. After considering the views of several departments, the principals decided that the value of 4.75 was a reasonable compromise.⁵⁸

The new American position, which Ambassador Wadsworth presented at the Geneva conference on February 11, 1960, proposed a ban on "all tests above ground up to the greatest heights to which effective controls can now be agreed, all tests in the oceans, and all underground tests" above the 4.75 threshold. The United States also proposed a joint research program involving Soviet, British, and American scientists to improve underground detection techniques so that the threshold could be lowered in time.⁵⁹

The Soviet response, which Tsarapkin presented in Geneva on March 19, raised a number of problems, probably intentionally, for the Americans. The Soviet Union agreed to all the terms in the American proposal, including the 4.75 threshold, but added one of its own: all three powers would agree to forego all tests in all three media, including underground tests below the threshold, during a period of joint research. First, an executive agreement on a moratorium going beyond the end of Eisenhower's term as president on January 20, 1961, presented a legal difficulty; its remedy appeared to be a formal treaty binding Eisenhower's successor, but all the principals agreed that such a treaty could not be ratified. Second, and more serious, the length of the moratorium was a problem. The Americans believed that the joint research program on the seismic detection system would take about five years, and the Soviet delegates now privately acknowledged that fact. Could the United States forego testing for that long a time? Could the nation resume testing if the joint research program led to no agreement with the Soviets on the detection system? Herter, now Secretary of State, recognized the importance of all these concerns; but he also reminded the principals that, in the face of growing opposition to testing throughout the world, the United States had to come up with a positive response. The British considered the Soviet proposal a significant breakthrough, and their views could not be dismissed lightly.⁶⁰

The Soviet proposal raised especially difficult problems for McCone and the Commission. McCone immediately objected, as all the principals must have expected, that the Soviet plan amounted to nothing more than a comprehensive test ban without safeguards; the United States' position had always been that it would not accept any test ban that could not be effectively policed. McCone also argued that, contrary to the Soviet contention, it would be impossible to construct an adequate detection system without some underground testing. Going one step further, he insisted that the United States should not give up the option to conduct underground tests in the interim. Two weeks earlier he had received a warning from Starbird

that morale in the weapon laboratories was sagging while the question of resuming testing hung in the air. On March 14, McCone had told Eisenhower that the laboratories could do all the testing they needed underground. He had mentioned to the President that important development work could be accomplished by using the experiments employed in safety tests. Eisenhower had asked for a written proposal, which he said he would probably approve, with the condition that "this experimentation does not constitute nuclear testing in the sense of the Geneva discussions, and that we do not regard it as nuclear testing."⁶¹

In a meeting with the principals on March 24, however, the President was still determined to "probe in every way the sincerity and intent of the Soviet declaration on disarmament." He thought some positive response was preferable to standing pat on the United States' position of February 11; for that purpose he intended to adopt the State Department's recommendation: The United States would agree at the time the treaty was signed to simultaneous declarations by the three powers that they would refrain from all nuclear tests not prohibited by the treaty for an agreed period while the joint research program was in progress, while the control system was being installed, and while there were no indications that the declarations were being violated. The length of the moratorium would not be specified in the statement, but the President said that he was thinking of one year or, if the Russians insisted, possibly two. McCone vigorously objected on the usual grounds. He proposed that the United States negotiate only on the basis of the threshold proposal already made. If the Soviet Union rejected this offer, McCone thought that the President should declare unilaterally that the United States would not test in the atmosphere or where significant fallout could occur but would reserve the right to test underground while proceeding to improve the seismic detection system. Eisenhower replied that he sympathized with McCone's argument, but he did not see how the proposed moratorium could harm the United States. When McCone continued to press the issue, the President informed him in a sharp tone that the State Department's position would be adopted.⁶²

The following week McCone poured out his frustration in a conversation with Lewis Strauss. He said he was getting the kind of treatment that Strauss had received in 1958 and he was "pretty damned sore about it." McCone was particularly annoyed because he believed that the State Department was misrepresenting the Soviet proposal to the Joint Committee and was attempting to build support for the counterproposal through leaks to newspaper columnists. He was disgusted with the scientists, particularly Bethe, who did not seem able to separate political opinion from scientific fact. Eisenhower, McCone admitted, might want to give priority to political factors until the next presidential election, and in that case his usefulness to the Administration might be ended. Strauss urged McCone not to think of resigning because he was a valuable "balance wheel" in the debate.⁶³

FADING HOPES FOR A TEST BAN

McCone's worst fears failed to materialize, not because the President changed his policy, but because continued disagreement at the Geneva conference pushed hopes for a treaty, even of the limited scope proposed in March 1960, far into the future. Both sides stopped short of any action that would result in a final collapse of negotiations. The Soviet Union rejected the new position of the United States but continued to discuss the proposed joint research program, while a technical panel under Panofsky developed detailed plans. Then the U-2 spy plane incident and abrupt cancellation of the Paris summit conference in May momentarily threatened the future of the negotiations. Once both sides declared their intention to continue, the negotiations resumed at the usual tortuous pace as the Americans tried to iron out countless difficulties in formulating a joint seismic research program that would be politically and technically acceptable to both sides. The most serious obstacle was specifying the nuclear device that would be used in an underground experiment. The United States first proposed a "black box," a nuclear device so packaged that no weapon test data could be derived from it. When the Soviet Union rejected this idea, the Americans then considered using obsolete nuclear weapons such as the Hiroshima gun-type weapon, but this suggestion led to endless complications; most important, Congress for political reasons could not in an election year vote to give the Russians and British access to weapon information unless the other nations were willing to reciprocate, and the Soviet Union was not willing to do that.⁶⁴

As the presidential election approached and Eisenhower's term drew toward its close, the ardent pursuit of a nuclear test ban gradually faded. Agreement with the Soviet Union still seemed as far away as it had in August 1958, when Eisenhower announced the moratorium and his determination to find a solution to the arms race. Now, in autumn 1960, it was clear that any agreement was at least years away, the responsibility of another president. And, wise to the workings of government, Eisenhower intended to leave that terrible problem to his successor.

CHAPTER 21

THE GREAT DEBATE

On the evening of January 17, 1961, three days before his second term ended, Dwight D. Eisenhower sat before a bevy of microphones and television cameras in the Oval Office for the last time as President to address the American people. It was eight years and one day since the President had met with the Atomic Energy Commissioners in that same room to hear a briefing on plans for enlarging the nuclear arsenal and then to learn about the loss of the Wheeler document. Since that day Eisenhower had been deeply immersed in the frightening issues posed by the bomb, and these issues were still very much on his mind in the closing days of his presidency.

As if to stress the serious import of his message, Eisenhower spoke slowly and deliberately as he struggled to make the words come out right. He spoke of "America's adventure in free government," of his efforts to keep the peace and "to enhance liberty, dignity and integrity among people and among nations. To strive for less would be unworthy of a free and religious people." But progress toward that goal had been threatened "by the conflict now engulfing the world." "We face," the President said, "a hostile ideology—global in scope, atheistic in character, ruthless in purpose, and insidious in method."¹

To many in his electronic audience Eisenhower's words sounded like the clichés that he had repeated with little apparent effect in the recent presidential campaign, but the chief executive was clearly attempting in his farewell address to place squarely before the American people the momentous issues that would face the nation in the years ahead. Keeping the peace would continue to require a strong military establishment and an armaments industry unprecedented in America's peacetime history. Vital as these new developments were, they held grave implications for the future. The President warned,

In the councils of government, we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. . . . Only an alert knowledgeable citizenry can compel the proper meshing of the huge industrial and military machinery of defense with our peaceful methods and goals, so that security and liberty may prosper together.

Of equal import for the future was what the President called the "technological revolution." Task forces of scientists, he noted, had replaced the solitary inventor in the nation's industrial and university laboratories.

Partly because of the huge costs involved, a government contract becomes virtually a substitute for intellectual curiosity. . . . In holding scientific research and discovery in respect, as we should, we must also be alert to the equal and opposite danger that public policy could itself become the captive of a scientific-technological elite.

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Eisenhower could not end his address without one last reference to the continuing imperative of disarmament.

Because this need is so sharp and apparent I confess that I lay down my official responsibilities in this field with a definite sense of disappointment. . . . As one who knows that another war could utterly destroy this civilization which has been so slowly and painfully built over thousands of years—I wish I could say tonight that a lasting peace is in sight.

All he could offer was that war had been avoided.

Between the fall elections and January's inauguration, the nation's oldest President and its youngest President-elect met twice: on December 6 and January 19. Some discussion focused on administrative details and emergency procedures in case of a nuclear attack, but Eisenhower did not neglect the great issues of consequence that had plagued him for eight years. He spoke at length about the dangers of nuclear war and his hopes that the moratorium on testing would lead eventually to disarmament, both nuclear and conventional. Eisenhower also warned Kennedy of the potentially dangerous effect that partisan politics could have on national policy. Perhaps recalling events of eight years earlier, the President harshly criticized the Joint Committee on Atomic Energy and what he saw as its pernicious influence in both domestic and international affairs. He hoped that Kennedy, with the support of a Democratic Congress, could propose legislation abolishing the committee.²

Hovering over all the President's hopes and fears, however, was the dark shadow of the hydrogen bomb. He had first learned of its terrifying power at the secret briefing at the Augusta golf club a month before his first

inauguration. The awesome results of the *Bravo* shot in 1954 had revealed the deadly terror posed by its potential radiation effects. Years of frustrating debate within his own Administration, dozens of proposals and counterproposals to the leaders of the Soviet Union, and his own personal appeals to the United Nations had merely postponed the cataclysm but had not dispersed the threatening cloud.

By 1960 Eisenhower's public statements had lost much of their earlier drive and focus. Like his farewell address, his speeches seemed to dissolve into a loose collection of platitudes. Inept as they often sounded, however, Eisenhower's words reflected the central role he had played in defining the place of the peaceful and military atom in American life. Unlike many politicians, he tended to look beyond the petty opportunities for advantage to the larger issues of war and peace. In fact, his proclivity for addressing such massive and intractable problems suggested a naiveté that hardened veterans of the political arena had learned to avoid. But Eisenhower seemed to sense that it was important to discuss these overriding issues of life and death, however unmanageable they appeared to be in their full dimensions, and to confront them in the simple and sometimes simplistic terms that the public could understand.

Likewise, the President's penchant for casting nuclear issues in moral terms again suggested naiveté at best or cynical manipulation of the public at worst. The truth, however, was that the development and control of nuclear technology did involve moral issues of great consequence, and Eisenhower was consciously trying to keep that truth before the eyes of the public.

In 1953 the military aspects of nuclear technology were not subjects for discussion even within the President's Cabinet, much less in the general public. Forcibly struck by top secret reports on the hydrogen bomb, Eisenhower had endorsed Operation *Candor* to give the American people a better understanding of the dangers of nuclear warfare. In the face of strong opposition from members of his Administration, the President continued to pursue that goal for almost a year, until he brought the issue squarely before the people of the United States and the world in his Atoms-for-Peace speech at the United Nations.

The United Nations speech in December 1953 gave new impetus to the effort already in motion to amend the Atomic Energy Act of 1946 in order to give private industry a role in developing nuclear technology and to encourage international cooperation in promoting Atoms for Peace. The debate over the new legislation, given added publicity by the Dixon-Yates fiasco, which itself resulted from a presidential decision, brought both the Atomic Energy Commission and nuclear issues into the political arena. During these same months in spring 1954 the transcript of the Oppenheimer security hearings, the result of another Eisenhower decision, became

a public document and revealed more about the inner workings of the atomic energy establishment than *Candor* ever could have.

The Administration's attempts during the next two years to move the development of nuclear power technology from the government to the private sector, to establish the International Atomic Energy Agency, to support EURATOM, and to produce more efficient nuclear weapons through an accelerated program of atmospheric testing not only created political issues that brought nuclear weapons for the first time into a presidential campaign in 1956 but also generated anxieties that seemed to strike at the heart of human existence itself. Only a relatively few Americans could appreciate the economic and political arguments raised by the public-versus-private power fight that the debate over nuclear power revived, but parents everywhere in the nation, if exposed to the facts, could ultimately see the potential threat of radioactive fallout to the health of their children.

Thus, by 1957, the place of nuclear energy in American life, an issue that for almost a decade had been confined to the secret councils of the federal government, had become the subject of a significant public debate. Moreover, the enormity of the potential destructive capability of thermonuclear weapons had given that debate moral dimensions that few Americans could ignore. Did the threat posed by "a hostile ideology—global in scope, atheistic in character, ruthless in purpose, and insidious in method," in the President's words, justify the immediate hazards of atmospheric testing and the ultimate risk of global nuclear war?

Probably no American leader at the time wrestled harder with that dilemma than did Eisenhower. It fired his determination to find a way out of the nuclear nightmare by turning the genius of the world's scientists to the arts of peace. Nuclear disarmament became a cardinal objective of his Administration, and the failure to achieve it drove the President in 1958 to impose an unpoliced, unilateral moratorium on United States testing of nuclear weapons.

Underlying the rising public debate during the Eisenhower years was another moral concern deeply buried in the psyches of many who had brought the world into the nuclear age at Hiroshima in 1945 and at Eniwetok in 1954: to expiate that sense of personal guilt by finding in nuclear technology some redeeming values for the human race. Eisenhower, who himself did not share that sense of guilt, gave renewed hope to those who did when he launched the Atoms-for-Peace program. The search for redeeming values, as much as the desire to demonstrate the superiority of the American system over Soviet communism, explained the fervor with which the Atomic Energy Commission and its scientists and engineers pursued the shining dreams of Atoms for Peace.

Thus, by the time the President gave his farewell address on January 17, 1961, he had both consciously and inadvertently built up the founda-

tions for the Great Nuclear Debate that would persist in the public arena for the next two decades and beyond. As the years passed, it would become a classic public debate in American history, of comparable historical importance to the debates over the ratification of the Constitution, the separation of church and state, the abolition of slavery, the free coinage of silver, the prohibition of alcohol, and the guarantee of civil rights. And while the Great Nuclear Debate continued, an anxious world awaited its outcome.

Appendixes

Appendix 1

Personnel

United States Atomic Energy Commission

Name

Gordon Dean, chairman	July 11, 1950	-	June 30, 1953
Henry DeWolf Smyth	May 30, 1949	-	Sept. 30, 1954
Thomas E. Murray	May 9, 1950	-	June 30, 1957
Thomas Keith Glennan	Oct. 2, 1950	-	Nov. 1, 1952
Eugene M. Zuckert	Feb. 25, 1952	-	June 30, 1954
Lewis L. Strauss, chairman	July 2, 1953	-	June 30, 1958
Joseph Campbell	July 27, 1953	-	Nov. 30, 1954
Willard F. Libby	Oct. 5, 1954	-	June 30, 1959
John Von Neumann	Mar. 15, 1955	-	Feb. 8, 1957*
Harold S. Vance	Oct. 31, 1955	-	Aug. 31, 1959*
John S. Graham	Sept. 12, 1957	-	June 30, 1962
John F. Floberg	Oct. 1, 1957	-	June 23, 1960
John A. McCone, chairman	July 14, 1958	-	Jan. 20, 1961
John H. Williams	Aug. 13, 1959	-	June 30, 1960
Robert E. Wilson	Mar. 22, 1960	-	Jan. 31, 1964
Loren K. Olson	June 23, 1960	-	June 30, 1962

*Date deceased in office

**Joint Committee on Atomic Energy
83rd Congress, 1953-1954**

W. Sterling Cole, chairman
Bourke B. Hickenlooper, vice-chairman

Senator	Bourke B. Hickenlooper (R)	Iowa
Senator	Eugene D. Millikin (R)	Colorado
Senator	William F. Knowland (R)	California
Senator	John W. Bricker (R)	Ohio
Senator	Guy R. Cordon (R)	Oregon
Senator	Richard B. Russell (D)	Georgia
Senator	Edwin C. Johnson (D)	Colorado
Senator	Clinton P. Anderson (D)	New Mexico
Senator	John O. Pastore (D)	Rhode Island
Representative	W. Sterling Cole (R)	New York
Representative	Carl Hinshaw (R)	California
Representative	James E. Van Zandt (R)	Pennsylvania
Representative	James T. Patterson (R)	Connecticut
Representative	Thomas A. Jenkins (R)	Ohio
Representative	Carl T. Durham (D)	North Carolina
Representative	Chet Holifield (D)	California
Representative	Melvin Price (D)	Illinois
Representative	Paul J. Kilday (D)	Texas
Executive Directors	William L. Bordon	
	Corbin C. Allardice	

84th Congress, 1955-1956

Clinton P. Anderson, chairman
Carl T. Durham, vice-chairman

Senator	Clinton P. Anderson (D)	New Mexico
Senator	Richard B. Russell (D)	Georgia
Senator	John O. Pastore (D)	Rhode Island
Senator	Albert Gore (D)	Tennessee
Senator	Henry M. Jackson (D)	Washington
Senator	Bourke B. Hickenlooper (R)	Iowa
Senator	Eugene D. Millikin (R)	Colorado
Senator	William F. Knowland (R)	California
Senator	John W. Bricker (R)	Ohio
Representative	Carl T. Durham (D)	North Carolina
Representative	Chet Holifield (D)	California
Representative	Melvin Price (D)	Illinois
Representative	Paul J. Kilday (D)	Texas
Representative	John J. Dempsey (D)	New Mexico
Representative	W. Sterling Cole (R)	New York

84th Congress, 1955–1956 (continued)

Representative	Carl Hinshaw (R)	California
Representative	James E. Van Zandt (R)	Pennsylvania
Representative	James T. Patterson (R)	Connecticut
Executive Director	Corbin C. Allardice James T. Ramey	

85th Congress, 1957–1958

Carl T. Durham, chairman
Clinton P. Anderson, vice-chairman

Senator	Clinton P. Anderson (D)	New Mexico
Senator	Richard B. Russell (D)	Georgia
Senator	John O. Pastore (D)	Rhode Island
Senator	Albert Gore (D)	Tennessee
Senator	Henry M. Jackson (D)	Washington
Senator	Bourke B. Hickenlooper (R)	Iowa
Senator	William F. Knowland (R)	California
Senator	John W. Bricker (R)	Ohio
Senator	Henry C. Dworshak (R)	Idaho
Representative	Carl T. Durham (D)	North Carolina
Representative	Chet Holifield (D)	California
Representative	Melvin Price (D)	Illinois
Representative	Paul J. Kilday (D)	Texas
Representative	John J. Dempsey ^a (D)	New Mexico
Representative	W. Sterling Cole ^b (R)	New York
Representative	James E. Van Zandt (R)	Pennsylvania
Representative	James T. Patterson (D)	Connecticut
Representative	Thomas A. Jenkins (R)	Ohio
Executive Director	James T. Ramey	

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^aWayne Aspinall was appointed March 17, 1958, to fill vacancy created by death of John J. Dempsey on March 11, 1958.

^bCraig Hosmer was appointed January 15, 1958, to fill the vacancy created by resignation of Sterling Cole on December 1, 1957, to become director general of the IAEA.

86th Congress, 1959–1960

Clinton P. Anderson, chairman
Carl T. Durham, vice-chairman

Senator	Clinton P. Anderson (D)	New Mexico
Senator	Richard B. Russell (D)	Georgia
Senator	John O. Pastore (D)	Rhode Island

86th Congress, 1959–1960 (continued)

Senator	Albert Gore (D)	Tennessee
Senator	Henry M. Jackson (D)	Washington
Senator	Bourke B. Hickenlooper (R)	Iowa
Senator	Henry C. Dworshak (R)	Idaho
Senator	George D. Aiken (R)	Vermont
Senator	Wallace F. Bennett (R)	Utah
Representative	Carl T. Durham (D)	North Carolina
Representative	Chet Holifield (D)	California
Representative	Melvin Price (D)	Illinois
Representative	Wayne N. Aspinall (D)	Colorado
Representative	Albert Thomas (D)	Texas
Representative	James E. Van Zandt (R)	Pennsylvania
Representative	Craig Hosmer (R)	California
Representative	William H. Bates (R)	Massachusetts
Representative	Jack Westland (R)	Washington
Executive Director	James T. Ramey	

General Advisory Committee

Isidor I. Rabi chairman, 1952-1956	Dec. 12, 1946 - Aug. 1, 1956
Oliver E. Buckley	Aug. 2, 1948 - Aug. 1, 1954
Willard F. Libby	Aug. 7, 1950 - Sept. 30, 1954 May 26, 1960 - Aug. 1, 1962
Eger V. Murphree	Aug. 7, 1950 - Aug. 1, 1956 Apr. 4, 1957 - Aug. 1, 1964
Walter G. Whitman	Aug. 7, 1950 - Aug. 1, 1956
John von Neumann	Feb. 27, 1952 - Aug. 1, 1954
James B. Fisk	Sept. 22, 1952 - Aug. 1, 1958
John C. Warner	Sept. 22, 1952 - Aug. 1, 1964
Eugene P. Wigner	Sept. 22, 1952 - Nov. 19, 1956 Dec. 3, 1959 - Aug. 1, 1962
Edwin M. McMillen	Oct. 23, 1954 - Oct. 7, 1958
Jesse W. Beams	Oct. 23, 1954 - Aug. 1, 1960
Warren C. Johnson chairman, 1956-1959	Oct. 23, 1954 - Aug. 1, 1960
T. Keith Glennan	Oct. 26, 1956 - Sept. 12, 1958
Edward Teller	Oct. 26, 1956 - July 9, 1958
Robert E. Wilson	Oct. 26, 1956 - Mar. 22, 1960
Kenneth S. Pitzer chairman, 1960-1961	Oct. 27, 1958 - Aug. 1, 1964
James W. McRae	Oct. 29, 1958 - Feb. 2, 1960
Manson Benedict	Oct. 29, 1958 - Aug. 1, 1962

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Military Liaison Committee

Chairmen

Robert LeBaron	Oct. 1, 1949 - Aug. 1, 1954
Herbert B. Loper	Aug. 2, 1954 - July 14, 1961

Army Members

Brig. Gen. Harry McK. Roper	Aug. 21, 1952 - Aug. 26, 1955
Colonel Kenner F. Hertford	Nov. 1, 1952 - Oct. 5, 1954
Brig. Gen. John P. Daley	Oct. 5, 1954 - Oct. 1, 1958
Brig. Gen. Thomas M. Watlington	Aug. 26, 1955 - Dec. 29, 1955
Major Gen. John S. Upham	Dec. 29, 1955 - July 13, 1956
Major Gen. John E. Theimer	July 13, 1956 - Sept. 15, 1956
Brig. Gen. Dwight E. Beach	Sept. 15, 1956 - July 1, 1959
Major Gen. William W. Dick	Oct. 1, 1958 - July 11, 1960
Brig. Gen. John T. Snodgrass	July 1, 1959 - July 18, 1961
Colonel Walter T. Kerwin, Jr.	July 11, 1960 - Sept. 1, 1960
Brig. Gen. David C. Lewis	Sept. 1, 1960 - July 9, 1962

Navy Members

Captain James S. Russell	Apr. 18, 1952 - Apr. 5, 1954
Rear Adm. George C. Wright	Nov. 18, 1952 - Sept. 26, 1955

Military Liaison Committee (continued)

Captain Paul H. Ramsey	Apr. 5, 1954 - Dec. 13, 1955
Rear Adm. Courtney Shands	Sept. 26, 1955 - Dec. 27, 1956
Rear Adm. David L. McDonald	Dec. 13, 1955 - Oct. 24, 1957
Captain James H. Flatley, Jr.	Oct. 24, 1957 - Mar. 25, 1958
Rear Adm. G. Serpell Patrick	May 10, 1957 - Mar. 17, 1958
Captain Joseph A. Jaap	Mar. 17, 1958 - Sept. 23, 1958
Captain Joseph D. Black	Mar. 25, 1958 - Nov. 25, 1958
Captain Frederick L. Ashworth	Sept. 23, 1958 - July 2, 1959
Rear Adm. William E. Ellis	Nov. 25, 1958 - Dec. 28, 1959
Captain Harold G. Brown	July 2, 1959 - Sept. 21, 1959
Captain John N. Shafer	Sept. 21, 1959 - Feb. 8, 1961
Rear Adm. C.S. Cooper	Dec. 28, 1959 - Apr. 26, 1960
Rear Adm. Frank A. Brandley	Apr. 26, 1960 - Apr. 16, 1962

Air Force Members

Major Gen. H.G. Bunker	Oct. 3, 1951 - Oct. 29, 1954
Major Gen. J.E. Briggs	Mar. 5, 1952 - May 2, 1954
Major Gen. H.B. Thatcher	May 3, 1954 - Sept. 24, 1956
Brig. Gen. Richard T. Coiner, Jr.	Oct. 29, 1954 - Aug. 1, 1958
Major Gen. John S. Mills	Sept. 24, 1956 - July 3, 1958
Major Gen. Leland S. Stranathan	July 3, 1958 - May 29, 1959
Major Gen. Charles H. Anderson	Aug. 1, 1958 - May 15, 1960
Major Gen. Marvin C. Demler	May 29, 1959 - Nov. 23, 1959
Brig. Gen. Paul T. Preuss	Nov. 23, 1959 - Mar. 28, 1960
Brig. Gen. Ralph L. Wassell	Mar. 28, 1960 - Nov. 1, 1962
Major Gen. Bruce K. Holloway	May 15, 1960 - Oct. 10, 1961

Laboratory Directors

United States Atomic Energy Commission, 1953-1960

Ames Laboratory

Frank H. Spedding 1948-1968

Argonne National Laboratory

Walter H. Zinn 1946-1956

Norman Hilberry 1957-1961

Brookhaven National Laboratory

Leland J. Haworth 1948-1961

Los Alamos Scientific Laboratory

Norris E. Bradbury 1945-1970

Oak Ridge National Laboratory

Clarence E. Larson 1950-1955

Alvin M. Weinberg 1955-1974

Radiation Laboratory-Berkeley

Ernest O. Lawrence 1936-1958

Edwin M. McMillan 1958-1973

Sandia Laboratory^a

Donald A. Quarles	1952-1953
James W. McRae	1953-1958
Julius P. Molnar	1958-1959
Siegmund P. Schwartz	1960-1965

Livermore Laboratory

Herbert F. York	1952-1958
Edward Teller	1958-1960

^aThe actual title was president, not director.

Appendix 2

AEC Ten-Year Summary of Financial Data (in millions of dollars)

	1952	1953	1954	1955
Cost of Operations ^a	684.1	904.7	1,039.1	1,289.5
Procurement of Raw Materials	72.5	82.2	142.8	193.6
Production of Nuclear Materials	205.7	318.3	409.7	588.4
Weapons Development and Fabrication	229.2	257.5	250.0	258.7
Development of Nuclear Reactors	64.4	104.1	99.3	114.6
Civilian	1.6	6.4	16.2	21.4
Military	39.5	53.2	42.0	53.0
Other	23.3	44.5	41.1	40.2
Physical Research	34.7	41.8	43.6	48.2
Controlled Thermonuclear	0.2	0.8	1.7	4.7
High Energy Physics	5.9	8.6	7.8	8.6
Other	28.6	32.4	34.1	34.9
Biology and Medicine Research	24.5	26.3	27.0	28.9
Community Operations — Net	16.4	15.2	11.8	10.3
Administrative Expenses	31.4	35.5	34.7	34.0
Other Expenses and Income Net	5.3	23.8	20.2	12.8
Plant Construction and Equipment Costs Incurred During the Year	1,082.2	1,125.6	1,215.1	842.5
Total AEC Assets Excluding Inventories of Certain Products at June 30	4,692.6	8,014.5	8,144.4	8,077.8
Plant Investments at June 30 (Gross)	3,496.8	4,579.1	5,705.3	6,487.4
Production Plants	1,327.3	2,118.1	2,957.8	4,645.8
Research & Development Facilities	338.8	548.0	616.5	707.1
Other	467.7	483.4	515.9	505.5
Plant Construction in Progress at June 30	1,363.0	1,429.6	1,615.1	629.0
Funds Appropriated — Net Operations	1,605.8	4,136.5	1,042.5	1,209.9
Plant Acquisition and Construction	—	808.9	886.5	1,099.0
	—	3,327.5	156.0	110.9

^aIncludes depreciation.

1956	1957	1958	1959	1960	1961
<u>1,608.0</u>	<u>1,918.2</u>	<u>2,288.6</u>	<u>2,496.6</u>	<u>2,619.1</u>	<u>2,615.8</u>
278.9	397.8	596.4	700.0	716.5	636.8
731.0	762.8	750.2	713.2	731.3	732.5
280.8	337.2	433.5	492.0	505.5	515.5
<u>168.9</u>	<u>255.7</u>	<u>306.2</u>	<u>355.6</u>	<u>399.2</u>	<u>437.3</u>
33.5	42.0	52.5	78.3	100.1	102.3
97.0	158.4	173.1	180.3	186.7	201.2
38.4	55.3	80.6	97.0	112.4	133.8
56.5	69.6	87.7	112.3	132.8	154.1
7.0	11.1	19.0	27.7	32.1	30.1
12.0	17.6	19.1	27.5	32.3	47.5
37.5	40.9	49.6	57.1	68.4	76.5
29.8	33.1	36.0	42.8	48.9	53.9
9.0	8.9	11.2	9.9	7.1	4.5
38.2	38.5	46.4	50.1	51.2	57.4
14.9	14.6	21.0	20.7	26.6	23.8
<u>301.7</u>	<u>317.0</u>	<u>289.7</u>	<u>299.0</u>	<u>331.5</u>	<u>432.7</u>
<u>7,368.3</u>	<u>7,397.9</u>	<u>7,652.8</u>	<u>7,764.8</u>	<u>7,689.4</u>	<u>7,802.4</u>
<u>6,713.1</u>	<u>6,907.9</u>	<u>7,110.8</u>	<u>7,292.8</u>	<u>7,344.8</u>	<u>7,664.8</u>
5,212.8	5,392.5	5,494.4	5,552.7	5,458.2	5,453.6
753.5	792.6	937.7	1,124.5	1,271.3	1,435.0
499.8	411.6	407.5	365.8	288.6	313.4
247.0	311.2	271.2	249.8	326.7	462.8
<u>834.2</u>	<u>1,898.7</u>	<u>2,334.0</u>	<u>2,635.3</u>	<u>2,649.6</u>	<u>2,666.7</u>
1,146.4 ^b	1,740.4	2,225.5	2,385.4	2,387.1	2,456.2
(312.2) ^b	158.3	108.5	249.9	262.5	210.5

^bIncludes transfer to operations of \$571 million appropriated in prior years as plant and equipment funds.

Source: U.S. Atomic Energy Commission, "Financial Report for 1961," Appendix 16 in *Major Activities in the Atomic Energy Programs, January-December 1961* (Washington: GPO, 1962).

Appendix 3

AEC Ten-Year Summary of Employment

	1952	1953	1954	1955	1956
Employment at June 30	149,443	148,846	142,021	112,618	110,197
AEC Employees	6,734	6,941	6,195	6,076	6,637
Operating Contractor Employees	58,101	71,775	73,312	82,936	90,238
Construction Contractor Employees	84,608	70,130	62,514	23,606	13,322
<hr/>					
	1957	1958	1959	1960	1961
Employment at June 30	119,455	121,059	121,928	122,718	122,989
AEC Employees	6,910	7,107	6,855	6,907	6,846
Operating Contractor Employees	98,176	103,290	105,195	104,612	103,313
Construction Contractor Employees	14,369	10,662	9,878	11,199	12,830

Source: U.S. Atomic Energy Commission, "Financial Report for 1961," Appendix 16 in *Major Activities in the Atomic Energy Programs, January-December 1961* (Washington: GPO, 1962).

Appendix 4

Announced U.S. Nuclear Tests, 1953–1958

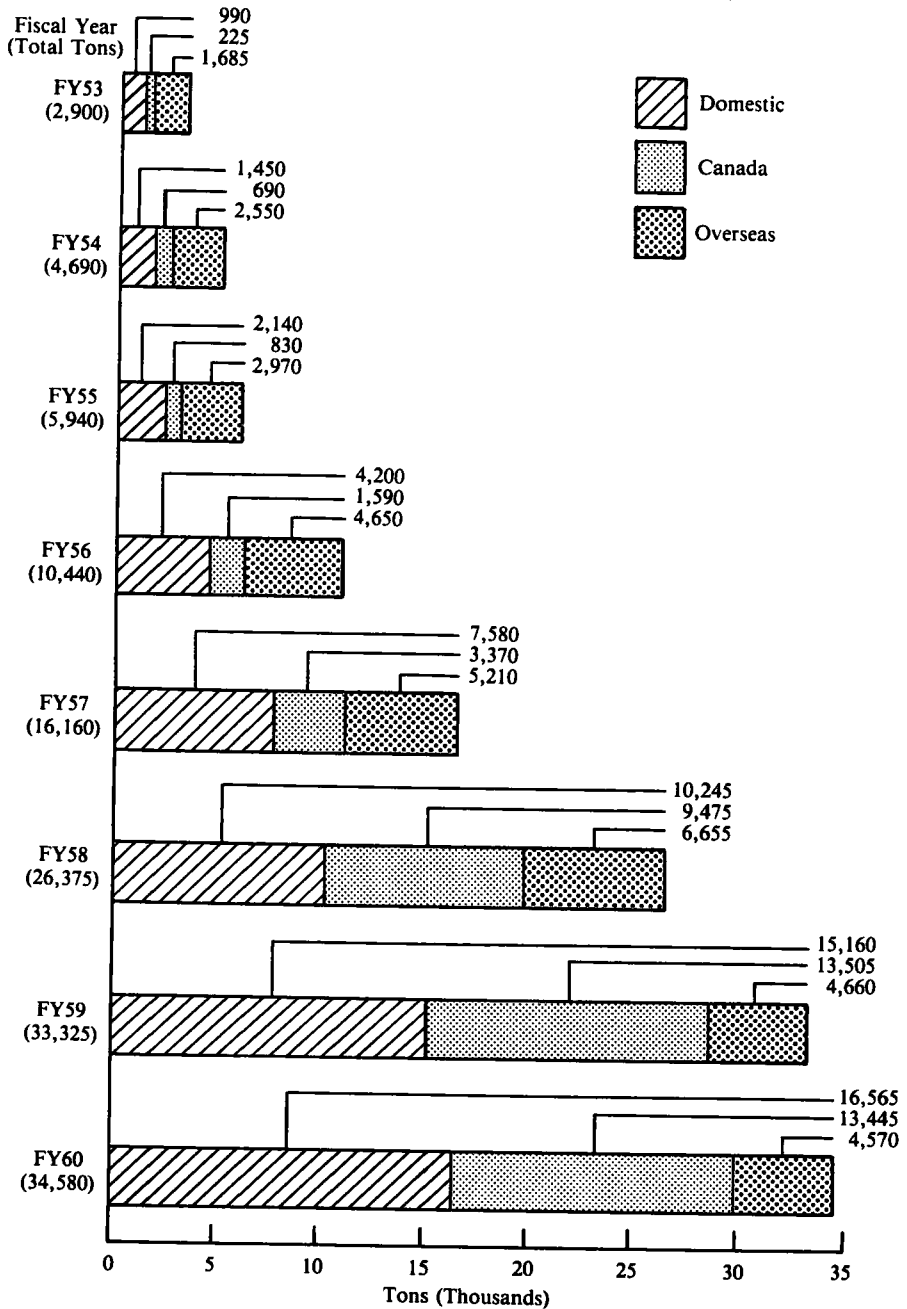
<u>Event</u>	<u>Dates</u>	<u>Location</u>	<u>Number of Shots</u>	<u>Purpose</u>
<i>Operation Upshot-Knothole</i>	3/53–6/53	Nevada Test Site	11	Weapon Related
<i>Operation Castle</i>	2/54–5/54	Bikini	6	Weapon Related
<i>Operation Teapot</i>	2/55–5/55	Nevada Test Site	14	Weapon Effects/ Weapon Related
<i>Operation Wigwam</i>	5/14/55	Pacific	1	Weapon Effects
<i>Project 56</i>	11/55–1/56	Nevada Test Site	4	Safety Experiments
<i>Operation Redwing</i>	5/56–7/56	Enewetak/ Bikini	17	Weapon Related
<i>Project 57</i>	4/24/57	Bombing Range	1	Safety Experiment
<i>Operation Plumbbob</i>	5/57–2/58	Nevada Test Site	30	Weapon Related/ Weapon Effects/ Safety Experiments
<i>Project 58</i>	12/57	Nevada Test Site	2	Safety Experiments
<i>Project 58 A</i>	3/14/58	Nevada Test Site	1	Safety Experiments
<i>Operation Hardtack I</i>	4/58–8/58	Pacific	35	Weapon Related/ Weapon Effects
<i>Operation Argus</i>	8/58–9/58	South Atlantic	3	Weapon Effects
<i>Operation Hardtack II</i>	9/58–10/58	Nevada Test Site	37	Safety Experiment/ Weapon Related

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Source: U.S. Department of Energy, Office of Public Affairs, *Announced United States Nuclear Tests. July 1945 through December 1983* (Las Vegas: Nevada Operations Office, 1984).

Appendix 5

Procurement of Uranium Concentrates (U_3O_8)



Source: U.S. Atomic Energy Commission, *Major Activities in the Atomic Energy Programs, January-December 1961* (Washington: GPO, 1962).

Appendix 6

Agreements for Cooperation in the Civil and Military Uses of Atomic Energy

Coun-tries	Agree-ments	Country	Scope	Effective Date	Termina-tion Date
1	1	Argentina	Research ^b	07-29-55	07-28-62
2	2	Australia ^a	Research & Power	05-28-57	05-27-67
3	3	Austria	Research	01-25-60	01-24-70
4	4	Belgium ^a	Research & Power ^b	07-21-55	07-31-65
5	5	Brazil	Research ^b	08-03-55	08-02-62
6	6	Canada ^a	Research & Power ^b	07-21-55	07-13-80
7	7	China, Republic of	Research ^b	07-18-55	07-17-62
8	8	Costa Rica	Research	02-08-61	02-07-66
9	9	Cuba	Research	10-10-57	10-09-62
10	10	Denmark	Research ^b	07-25-55	09-07-68
11	11	Dominican Republic	Research	12-21-56	12-20-61
12	12	Ecuador	Research	02-06-58	02-05-63
13	13	France	Research & Power ^b	11-20-56	11-19-66
14	14	Germany, Fed. Republic of	Research & Power ^b	08-07-57	08-06-67
	15	West Berlin, City	Research	08-01-57	07-31-62
15	16	Greece	Research ^b	08-04-55	08-03-62
16	17	Guatemala	Research	04-22-57	04-21-62
17	18	Indonesia	Research	09-21-60	09-20-65
18	19	Iran	Research	04-27-59	04-26-64
19	20	Ireland	Research ^b	07-09-58	07-08-63
20	21	Israel	Research ^b	07-12-55	07-11-62
21	22	Italy	Research & Power ^b	04-15-58	04-14-78
22	23	Japan	Research & Power ^b	12-05-58	12-04-68
23	24	Korea, Republic of	Research ^b	02-03-56	02-02-66
24	25	Netherlands ^a	Research & Power ^b	08-08-57	08-07-67
25	26	Nicaragua	Research	03-07-58	03-06-63
26	27	Norway	Research & Power	06-10-57	06-09-67
27	28	Philippines	Research ^b	07-27-55	07-26-63
28	29	Portugal	Research ^b	07-21-55	07-20-62
29	30	South Africa	Research & Power	08-22-57	08-21-67
30	31	Spain	Research & Power	02-12-58	02-11-68
31	32	Sweden	Research ^b	01-18-56	06-01-68
32	33	Switzerland	Research	07-18-55	07-17-65
	34	Switzerland ^a	Power ^b	01-29-57	01-28-67
33	35	Thailand	Research ^b	03-13-56	03-12-63
34	36	Turkey	Research ^b	06-10-55	06-09-65
35	37	United Kingdom ^a	Research & Power ^b	07-21-55	07-20-65
36	38	Venezuela	Research & Power	02-09-60	02-08-70
37	39	Viet-Nam	Research	07-01-59	06-30-64

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Mutual Defence Purposes Agreements^c

1. NATO ^a	Mar. 29, 1956
2. Australia ^a	Aug. 14, 1957
3. Canada ^a	July 27, 1959
4. France	July 20, 1959
5. France ^a	Oct. 9, 1961
6. Germany, Fed. Rep. ^a	July 27, 1959
7. Greece ^a	Aug. 11, 1959
8. Italy ^a	May 24, 1961
9. Netherlands ^a	July 27, 1959
10. Turkey ^a	July 27, 1959
11. United Kingdom ^a	Aug. 4, 1958
(Amendment to U.K. Agreement) ^a	July 20, 1959

^aClassified Agreements.

^bDenotes Agreement has been amended.

Special Agreements^c

1. European Atomic Energy Community (EURATOM) . . .
Joint Nuclear Program . . .
February 18, 1959.
2. European Atomic Energy Community (EURATOM) . . .
Additional Agreement . . .
July 25, 1960.
3. International Atomic Energy Agency (IAEA) . . . Supply of Materials, etc. . . .
August 7, 1959.

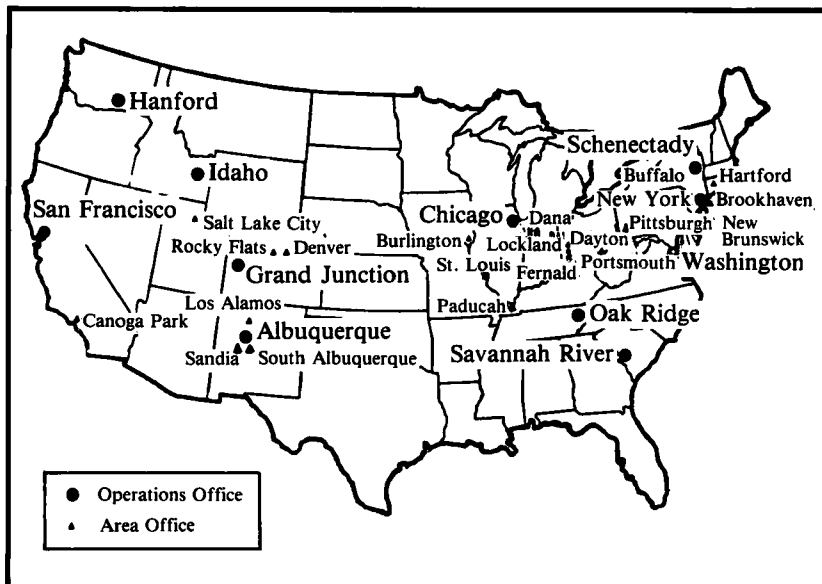
^cOnly the effective date shown for these agreements.

In effect: 25 research and 14 power agreements with 37 countries and West Berlin. 11 mutual defense purposes agreements, and 3 special agreements (IAEA and EURATOM). 5 other agreements had been signed. Of these, there were no plans for ratification for Cuba, Iraq, Peru and Panama. Brazil anticipated ratification.

Source: U.S. AEC, *Major Activities in Atomic Energy Programs, Jan.-Dec. 1961* (Washington: GPO, 1962).

Appendix 7

AEC Operations Offices (with the area offices supervised by each)



Albuquerque Operations Office
 Buffalo Area Office
 Burlington Area Office
 Dayton Area Office
 Los Alamos Area Office
 Rocky Flats Area Office
 Sandia Area Office
 South Albuquerque Area Office

Chicago Operations Office
 Hartford Area Office
 Lockland Area Office
 Pittsburgh Area Office

Grand Junction Operations Office
 Denver Area Office
 Salt Lake City Area Office

Hanford Operations Office

Idaho Operations Office

New York Operations Office
 Brookhaven Area Office

Oak Ridge Operations Office
 Fernald Area Office
 New Brunswick Area Office
 Paducah Area Office
 Portsmouth Area Office
 St. Louis Area Office

San Francisco Operations Office
 Southern California Area Office

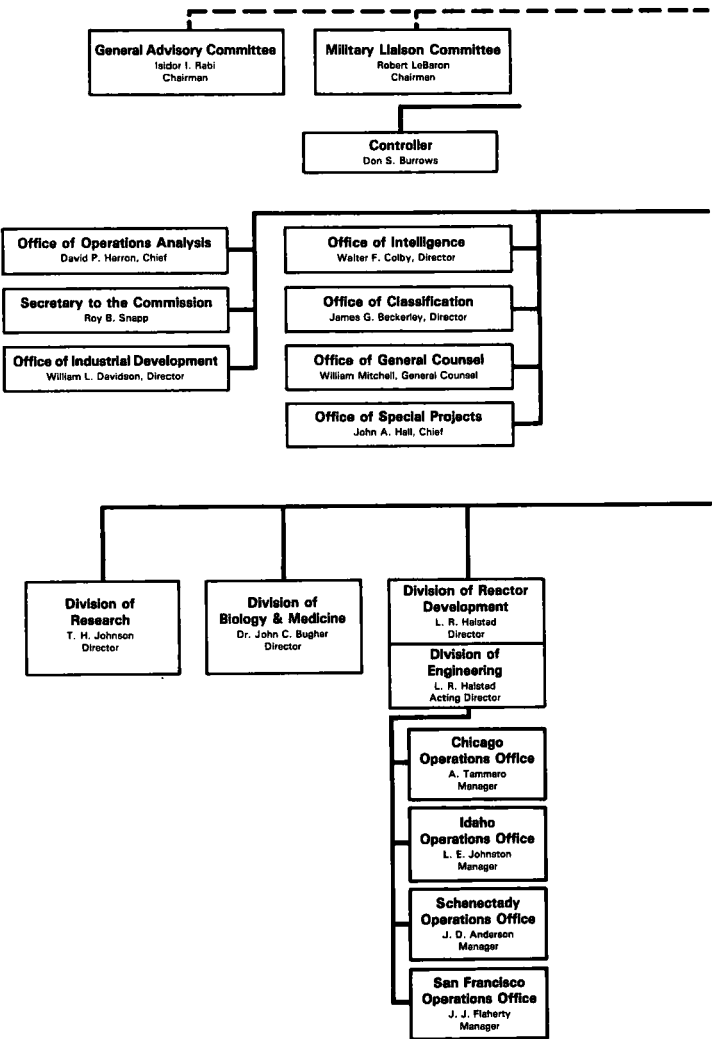
Savannah River Operations Office
 Dana Area Office

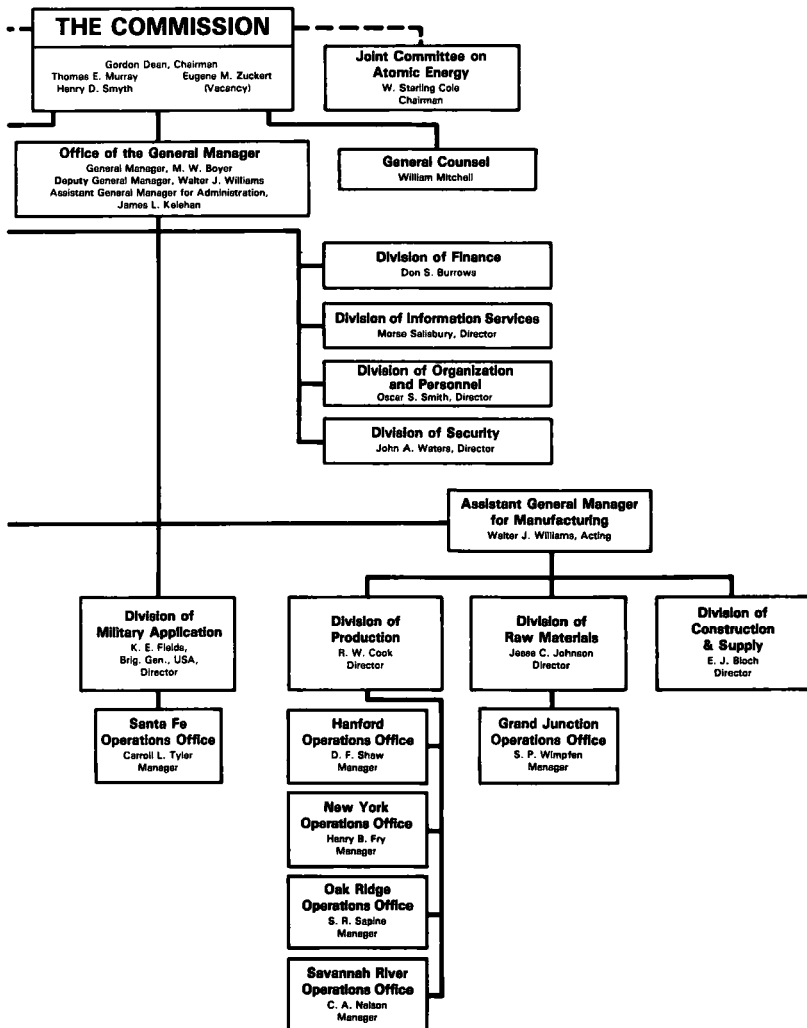
Schenectady Operations Office

Source: U.S. Atomic Energy Commission, *Atomic Energy Facts* (Washington: GPO, 1957).

Appendix 8
AEC Organization Charts,
May 1953–September 1958
(see following pages)

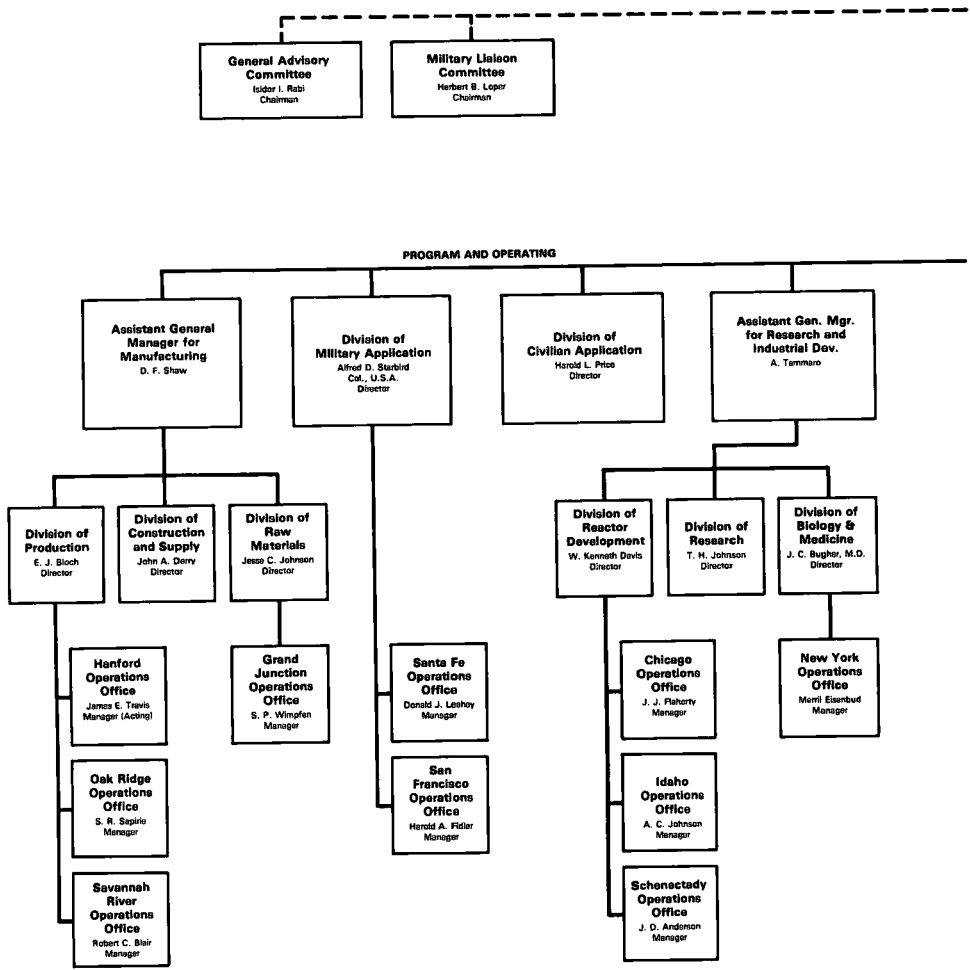
AEC Organization Chart, May 1953

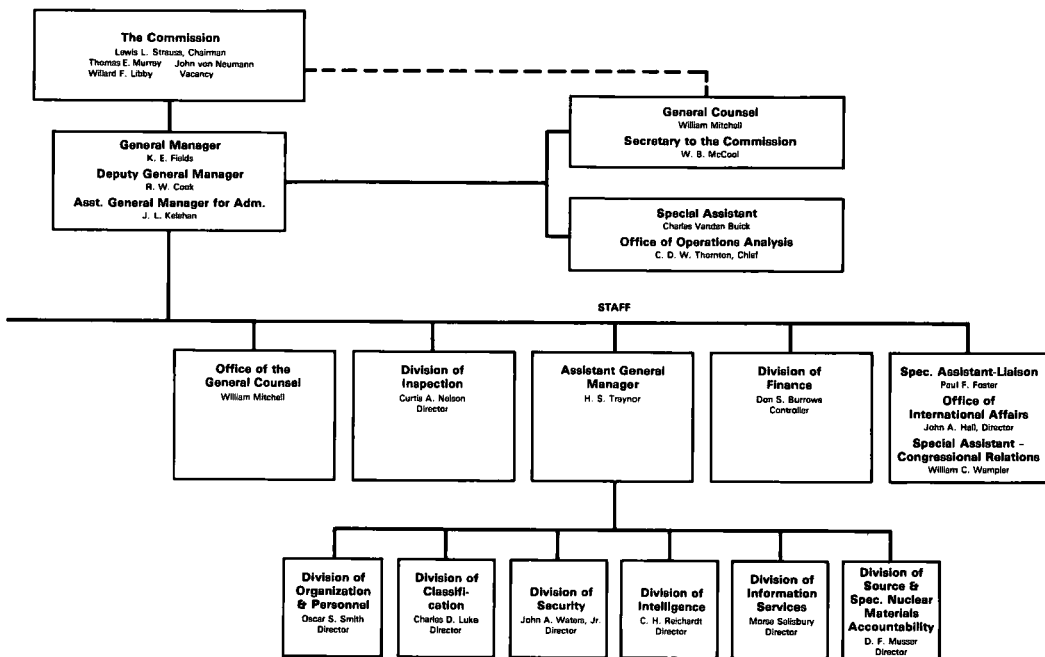




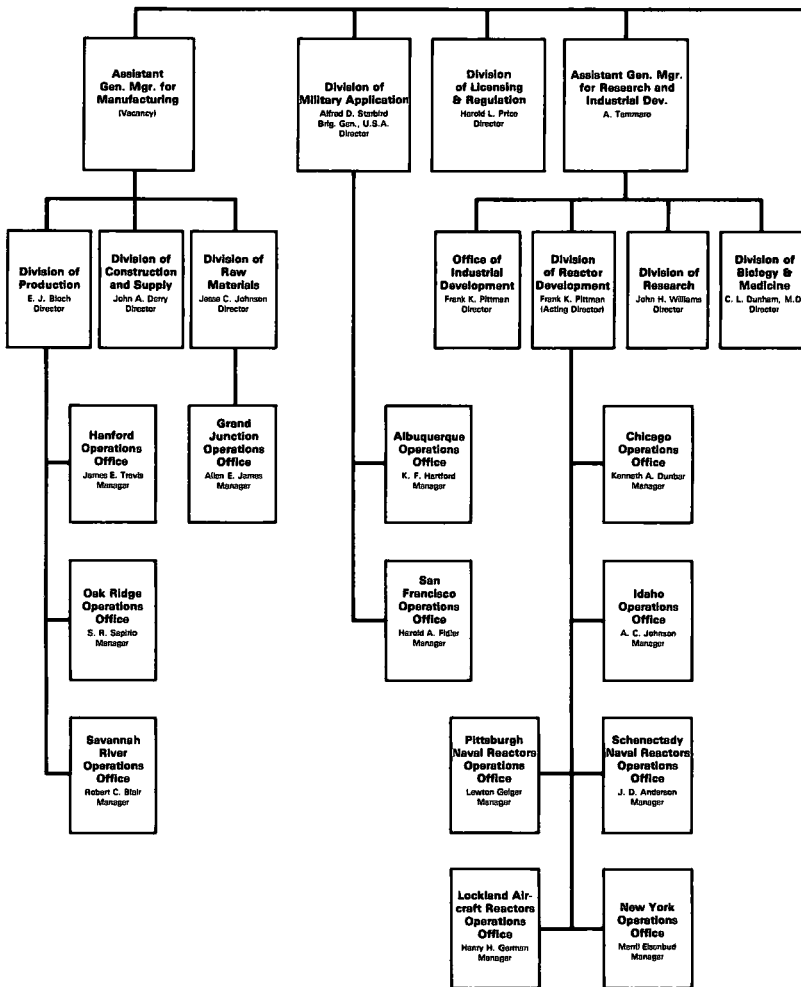
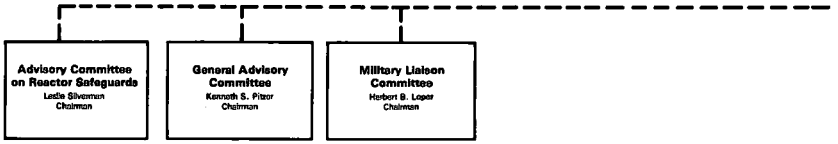
AEC Organization Chart, July 1955

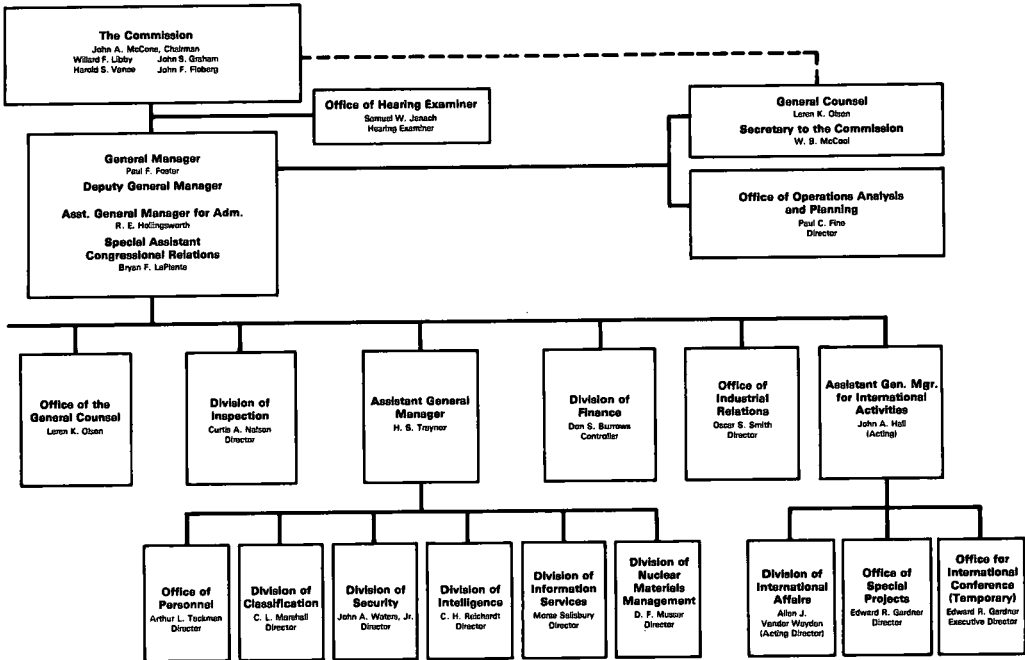
586





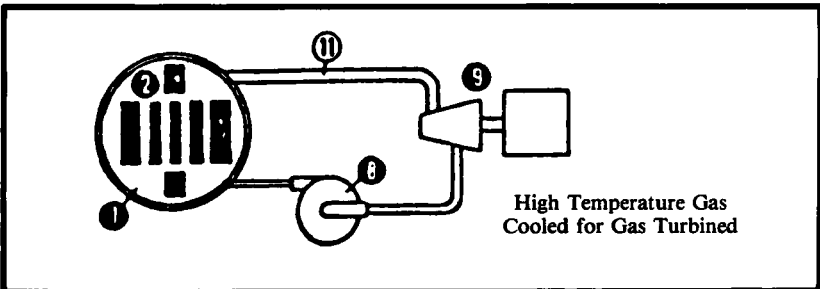
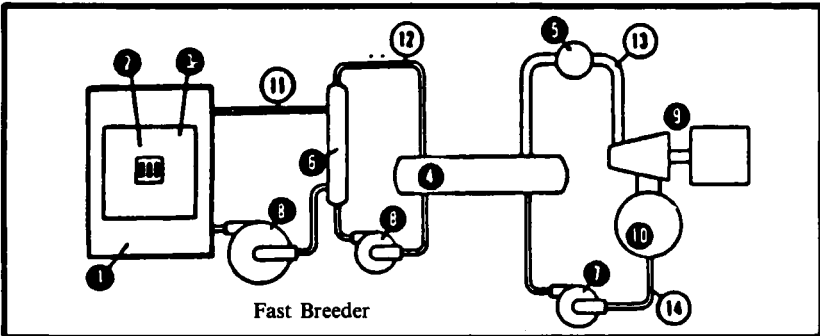
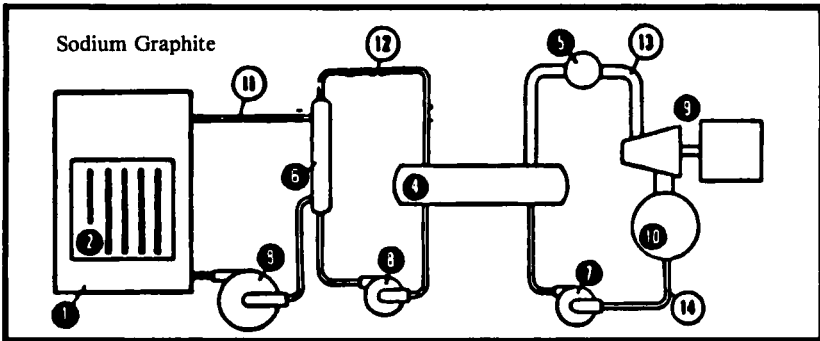
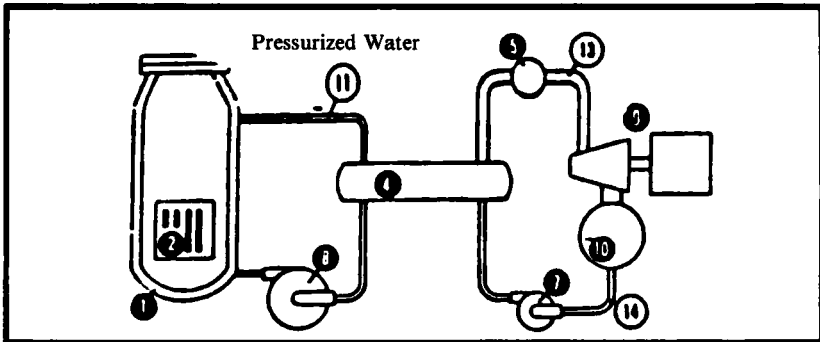
AEC Organization Chart, September 1958

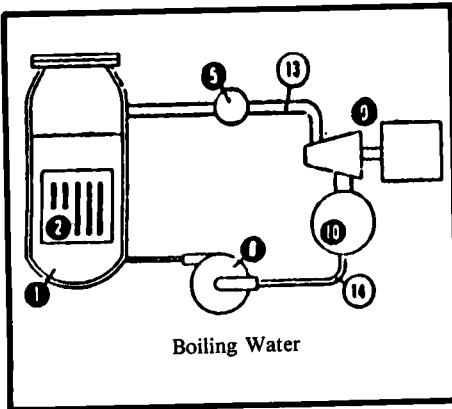
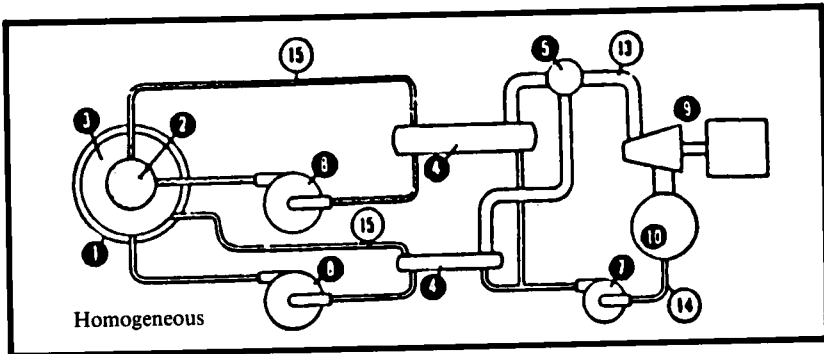
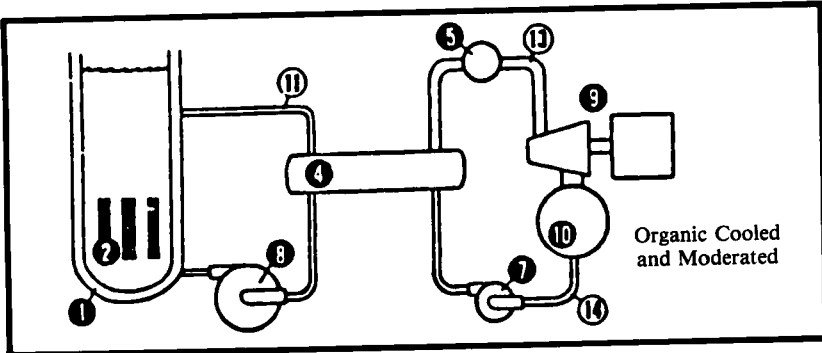
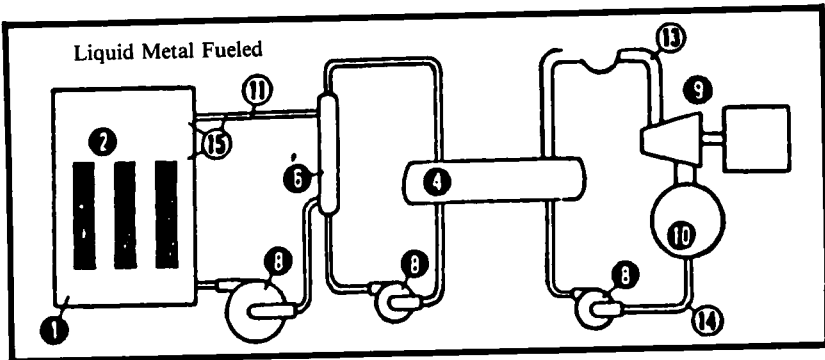




Appendix 9

Eight Basic Reactor Systems Being Developed





Features

- | | |
|-------------------------------|------------------------|
| ① Reactor | ⑧ Circulating Pump |
| ② Core | ⑨ Turbo-generator |
| ③ Blanket | ⑩ Condenser |
| ④ Boiler | ⑪ Primary Coolant |
| ⑤ Steam Drier | ⑫ Intermediate Coolant |
| ⑥ Intermediate Heat Exchanger | ⑬ Steam |
| ⑦ Feedwater Pump | ⑭ Condensate |
| | ⑮ Circulating Fuel |

ABBREVIATIONS

ACBM	Advisory Committee on Biology and Medicine
AEC	Records of Headquarters, U.S. Atomic Energy Commission, Washington, D.C.
BOB	Records of the Bureau of the Budget, Washington, D.C.
CDJ	Papers of Charles D. Jackson, Eisenhower Library, Abilene, KS
CM 1	Commission meeting 1, U.S. Atomic Energy Commission
CR	Congressional Record
DDE	Papers of Dwight D. Eisenhower, Eisenhower Library, Abilene, KS
DOE	Records of the U.S. Department of Energy, Washington, D.C.
DOS	Records of the U.S. Department of State, Washington, D.C.
FBI	Records of the Federal Bureau of Investigation, Washington, D.C.
FCDA	Records of the Federal Civil Defense Administration, Washington, D.C.
FPC	Records of the Federal Power Commission, Washington, D.C.
GAC 1	Meeting 1 of the General Advisory Committee to the U.S. Atomic Energy Commission
HDS	Papers of Henry D. Smyth, Princeton, NJ
IAEA	International Atomic Energy Agency
JCAE	Records of the Joint Committee on Atomic Energy, National Archives, Washington, D.C.
JRO	Papers of J. Robert Oppenheimer, Library of Congress, Washington, D.C.
LASL	Records of Los Alamos Scientific Laboratory, Los Alamos, NM

ABBREVIATIONS

LLS	Papers of Lewis L. Strauss, Hoover Library, West Branch, IA
NSC	Records of the National Security Council, Washington, D.C.
OMB	Records of the Office of Management and Budget, Washington, D.C.
PSAC	President's Science Advisory Committee
SNSC	Summary, National Security Council
TEM	Papers of Thomas E. Murray, Washington, D.C.
UCRL	Records of the University of California Radiation Laboratory, Lawrence Livermore National Laboratory, Livermore, CA (formerly LLNL)

NOTES

These notes are intended as a guide to the material and records we consulted and should not be considered a rigorous citation of all the documentary evidence available. Neither should the citation of specific documents be interpreted to mean that the materials are necessarily unclassified or available to the public. We have, however, in the source abbreviations, indicated where the records we used are located. The Essay on Sources provides an additional guide to the archival and secondary literature pertinent to the history of atomic energy during the Eisenhower Administration. Except for those materials cited as being in the files of the Atomic Energy Commission, none of the materials are now available to the historical staff, and requests for access should be directed to the organization or archives cited in each note.

FOREWORD

1. For helpful surveys of Eisenhower historiography, see Vincent P. De Santis, "Eisenhower Revisionism," *The Review of Politics* 38 (April 1976): 190-207; Gary Reichard, "Eisenhower as President: The Changing View," *South Atlantic Quarterly* 77 (Summer 1978): 265-81; Stephen E. Ambrose, "The Ike Age," *The New Republic* (May 9, 1981): 26-34; Mary S. McAuliffe, "Commentary/Eisenhower, the President," *The Journal of American History* 68 (December 1981): 625-32; Arthur M. Schlesinger, Jr., "The Ike Age Revisited," *Reviews in American History* 9 (March 1983): 1-11; Anthony James Joes, "Eisenhower Revisionism: The Tide Comes In," *Presiden-*

tial Studies Quarterly 15 (Summer 1985): 561-71; Steve Neal, "Why We Were Right to Like Ike," *American Heritage* 37 (December 1985): 49-64; Robert J. McMahon, "Eisenhower and Third World Nationalism: A Critique of the Revisionists," *Political Science Quarterly* 101 (1986): 453-73; Robert F. Burk, "Bibliographic Essay," *Dwight D. Eisenhower: Hero and Politician* (Boston: G. K. Hall, 1986); Richard A. Melanson and David Mayers, "Preface," *Reevaluating Eisenhower: American Foreign Policy in the Fifties* (Urbana: University of Illinois Press, 1987); Stephen G. Rabe, "Introduction," *Eisenhower and Latin America: The Foreign Policy of Anticommunism* (Chapel Hill: the University of North Carolina Press, 1988); Gary W. Reichard,

"Bibliographical Essay," *Politics as Usual: The Age of Truman and Eisenhower* (Arlington Heights, Ill.: Harlan Davidson, 1988).

2. McMahon, "Eisenhower and Third World Nationalism," 457.

CHAPTER ONE

1. Richard G. Hewlett and Francis Duncan, *Atomic Shield, 1947-1952*, Vol. II of *A History of the U.S. Atomic Energy Commission* (University Park: Pennsylvania State University Press, 1969), p. 317 (hereafter cited *Atomic Shield*).
2. The following account of the meeting is based largely on Snapp's undated memorandum to file, probably written on Nov. 12, 1952, AEC.
3. *Atomic Shield*, pp. 437-38; *New York Times*, Nov. 11, 1952, p. 16.
4. Dean to Eisenhower, Nov. 7, 1952, AEC.
5. In the 1950s the name was spelled "Eniwetok," but the modern version "Enewetak" is used in this book.
6. AEC Press Release 374, May 25, 1951, AEC.
7. For background, see *Atomic Shield*, pp. 565-68.
8. *Ibid.*, pp. 388-91.
9. AEC Briefing Book, Nov. 1952, AEC.
10. Not all these figures were in the Briefing Book; some come from AEC Monthly Status and Progress Report, Nov. 1952, AEC.
11. Dean, opening remarks for meeting with Eisenhower, Nov. 19, 1952, attached to Nov. 19 entry in Dean Diary, AEC.
12. Dean Diary, Nov. 18, 1952, AEC.
13. The following description of the Commodore meeting is based on Murray's notes on Discussion with President-Elect Eisenhower, Nov. 19, 1952, TEM.
14. Dean Diary, Nov. 24, 1952, AEC.

CHAPTER TWO

1. Snapp to Scott McLeod, Jan. 10, 1953; Snapp to Styles Bridges, Jan. 10, 1953, both in AEC.
2. Herbert S. Parmet, *Eisenhower and the American Crusades* (New York: Macmillan, 1972), pp. 155-57.
3. AEC Controller, BOB Action on FY 1954

Budget Estimates, AEC 533/21, Jan. 21, 1953, AEC.

4. On the status of plant construction, see AEC Monthly Status and Progress Reports, Jan.-March, 1953, AEC. On plans for weapons tests, see D. Cooksey to K. E. Fields, Jan. 12, 1953, and N. E. Bradbury to Fields, Jan. 6, 1953, AEC.
5. Dodge to Dean, Feb. 3, 1953, AEC.
6. CM 826, Feb. 26, 1953; Division of Finance, Analysis of Special Review of 1954 Budget, Feb. 25, 1953; Smyth to Dodge, March 2, 1953, all in AEC.
7. National Security Council, Summary of Discussion (hereafter cited as SNSC), Meeting 134, Feb. 25, 1953, DDE; Military Liaison Committee Meeting 78, Feb. 18, 1953; CM 827, Feb. 27, 1953, both in AEC.
8. Dean to Wilson, March 13, 1953; Review of Military Requirements for Atomic Weapons, AEC 533/26, March 18, 1953, both in AEC; SNSC 137, March 18, 1953; Dodge to Strauss, March 19, 1953, both in DDE.
9. On Strauss's earlier career on the Commission, see Richard G. Hewlett and Francis Duncan, *Atomic Shield, 1947-1952*, Vol. II of *A History of the U.S. Atomic Energy Commission* (University Park: Pennsylvania State University Press, 1969), pp. 81, 109-10, 130-31, 283-99, 312-13, 373-74, 387-88, 394-95, 461-62 (hereafter cited *Atomic Shield*), and Lewis L. Strauss, *Men and Decisions* (Garden City, NY: Doubleday, 1962), pp. 201-30. For a recent biography of Strauss, see Richard Pfau, *No Sacrifice Too Great: The Life of Lewis L. Strauss* (Charlottesville: University Press of Virginia, 1984). For Strauss's account of his appointment, see Strauss, *Men and Decisions*, pp. 332-33. Announcements of Dean's intention to retire and of Strauss's selection appeared in *New York Times*, Feb. 11, 1953, p. 1, and March 8, 1953, p. 1.
10. Dean to Strauss, March 20, 1953; Dean to Eisenhower, March 20, 1953, both in AEC.
11. Dean to the Commissioners, Jan. 14, 1953, AEC.
12. *Atomic Shield*, pp. 494-98, 515; Richard G. Hewlett and Francis Duncan, *Nuclear Navy, 1946-1962* (Chicago: University of Chicago Press, 1974), pp. 175-79 (hereafter cited *Nuclear Navy*); W. H. Zinn, "Nuclear Power Generation Ad-

- vances to Prototype Stage," *Electric Light and Power* 30 (Oct. 1952): 112-19; "The Breeder Reactor," *Scientific American* 187 (Dec. 1952): 58-60.
13. Joint Committee on Atomic Energy, *Atomic Power and Private Enterprise*, Joint Committee Print, 82 Cong., 2 sess. (Washington: Government Printing Office, 1952); Durham to Dean, Aug. 19, 1952; Dean to Durham, Sept. 4, 1952, both in AEC.
 14. Director of Reactor Development, Overall Objectives and Program for Reactor Development, AEC 152/33, Dec. 9, 1952, AEC. For background on Hafstad, see *Atomic Shield*, pp. 209-20, 511-18.
 15. On Davidson, see AEC Press Release 423, May 1, 1952, AEC, and "AEC Bids Business Join the Feast," *Business Week*, Dec. 20, 1952, pp. 140-43.
 16. Directors of Industrial Development and Reactor Development, Development of Economic Nuclear Power, AEC 331/59, Jan. 23, 1953, AEC.
 17. Dean to Eisenhower, March 4, 1953, AEC. Earlier versions of the proposal were issued: AEC 331/62, Feb. 2, 1953; AEC 331/64, Feb. 6, 1953; AEC 331/66, Feb. 19, 1953, all in AEC. For Commission discussions of the papers, see: CM 811, Jan. 28, 1953; CM 813, Feb. 3, 1953; CM 820, Feb. 11, 1953; CM 824, Feb. 25, 1953; CM 830, March 4, 1953, all in AEC.
 18. SNSC 136, March 11, 1953, DDE. The proposal was distributed as NSC 145, The Development of Practical Nuclear Power, March 6, 1953, AEC. The Commission was formally notified of the NSC decision in James S. Lay to the AEC, March 12, 1953, AEC.
 19. Preface of Statement, AEC 331/69, March 19, 1953; CM 835, March 11, 1953; CM 840, March 20, 1953; Dean Diary, March 13, 16, 18, 20, 1953, all in AEC.
 20. Notes, Special NSC Meeting, March 31, 1953, DDE. See also Memorandum at a Special Meeting of the National Security Council, Tuesday, March 31, 1953, *Foreign Relations of the United States, 1952-1954, Vol. II, National Security Affairs* (Washington: Government Printing Office, 1984), pp. 264-81 (hereafter cited *FRUS, 1952-1954, II*).
 21. Murray to Dean, April 10, 1953, AEC; underlined in the original.
 22. The report is found as an attachment to Hugh D. Farley to Robert Cutler, April 2, 1953, DDE. The seven consultants were Dillon Anderson, James B. Black, John Cowles, Eugene Holman, Deane W. Malott, David B. Robertson, and Charles A. Thomas. See CM 838, March 16, 1953, AEC and Lay to NSC, March 17, 1953, DDE.
 23. From a Condensed Statement of Proposed Policies and Programs prepared by James S. Lay, executive secretary of the NSC, and sent to Dean by letter of April 3, 1953, AEC.
 24. Thomas K. McCraw, *TVA and the Power Fight* (Philadelphia: Lippincott, 1971), pp. 1-66; Philip J. Fungiello, *Toward A National Power Policy; The New Deal and the Electric Utility Industry* (Pittsburgh: University of Pittsburgh Press, 1973), pp. 1-148; Harry S. Truman, Address before the Electric Consumers Conference, May 26, 1952, *Public Papers of the Presidents, 1952-1953: Harry S. Truman* (Washington: Government Printing Office, 1966), pp. 370-74; *Electric Light and Power* 30 (Aug. 1952): 39; 30 (Dec. 1952): 144.
 25. *Newsweek*, April 13, 1953, p. 88; AEC Press Release 481, April 12, 1953; Atomic Industrial Forum, News Release, April 16, 1953; CM 859, May 1, 1953; Walker L. Cisler and Mark E. Putman to Dean, April 16, 1953, with attached proposals for revising the act, all in AEC. The Van Zandt bill was introduced as H.R. 4687, on April 20, 1953, *Congressional Record*, 83 Cong., 1 sess., pp. 3414, A2010. See also AEC General Counsel, Legislation on Atomic Power Development, AEC 615/3, April 30, 1953, AEC.
 26. Alex Radin to Dean, April 14, 1953, in AEC 331/74, April 17, 1953; O. A. Knight to Dean, April 23, 1953, in AEC 646, April 30, 1953, both in AEC.
 27. SNSC 140, April 22, 1953, DDE. See also Memorandum of Discussion at the 140th Meeting of the National Security Council, Wednesday, April 22, 1953, *FRUS, 1952-1954, II*, pp. 291-301. Dean, Memo on NSC Meeting, April 22, 1953; Lay to AEC, April 24, 1953, both in AEC.
 28. Murray to Dean, April 16, 1953, AEC; *Nuclear Navy*, pp. 196-98.
 29. Rickover to Dean, May 15, 1953, AEC.
 30. Snapp, Proposed letter to the President, April 28, 1953; Murray to Smyth, April

- 28, 1953; Smyth to Eisenhower, April 29, 1953; CM 859, May 1, 1953; Kyes to Cutler, May 4, 1953, all in AEC; "Thomas E. Murray and the PWR Project," typescript, p. 7, TEM.
31. SNSC 143, May 6, 1953, DDE; Smyth to NSC, May 6, 1953; Lay to Secretary of Defense and AEC, May 8, 1953; Joint Committee, Transcript of Executive Session, May 6, 1953, all in AEC.
 32. Cole to Dean, two letters dated May 15, 1953, in AEC 331/81, May 19, 1953, AEC.
 33. General Counsel, Draft letter to the Joint Committee, AEC 331/85, May 22, 1953; CM 868, May 25, 1953; CM 869, May 26, 1953; Joint Committee, Transcript of Hearing, May 26, 1953, all in AEC. The NSC policy statement appears in NSC Report 149/2, Basic National Security Policies and Programs in Relation to their Costs, April 29, 1953, *FRUS, 1952-1954, II*, pp. 307-16. The full NSC policy statement was transmitted by Smyth to Cole, May 29, 1953, AEC.
 34. The Commission considered two versions of the bill: AEC 615/8, May 11, 1953, and AEC 615/9, May 21, 1953, both in AEC. Dean presented the latter to the Joint Committee. For Commission discussions, see CM 862, May 13, 1953, and CM 864, May 20, 1953, both in AEC.
 35. CM 869, May 26, 1953, AEC.
 36. Dean Diary, June 3, 1953, AEC.
 37. Dean to Eisenhower, June 1, 1953; Strauss to Sherman Adams, June 8, 1953; Eisenhower to Dean, June 9, 1953; Strauss to Eisenhower, June 19, 1953; Mr. Strauss's Statement, June 24, 1953, all in DDE.
 38. *Washington Star*, June 26, 1953; *Washington Post*, June 27, 1953; *New York Times*, June 25, 1953; Bob Considine in the *New York Journal-American*, June 29, 1953; *Denver Post*, June 29, 1953; *Schenectady Gazette*, June 29, 1953; *Cincinnati Enquirer*, June 26, 1953; *Oak Ridge*, June 26, 1953; Joint Committee on Atomic Energy, *Hearings before the Senate Section on Confirmation of AEC Commissioners*, June 1953-March 1955 (Washington: Government Printing Office, 1955), pp. 1-3 (hereafter cited as *Confirmation Hearings*).
 39. *Confirmation Hearings*, pp. 5-8.
 40. Joint Committee on Atomic Energy, *Hearings on Atomic Power Development and Private Enterprise*, June 24-July 31,

1953 (Washington: Government Printing Office, 1953), pp. 562-70.

41. Cole to John Phillips, May 20, 1953, in AEC 533/32, May 27, 1953, AEC.
42. *Nuclear Navy*, pp. 228-34.

CHAPTER THREE

1. *Public Papers of the Presidents of the United States, 1953: Dwight D. Eisenhower* (Washington: Government Printing Office, 1960), p. 2 (hereafter cited *Public Papers, 1953, Eisenhower*).
2. Durham to Eisenhower, Jan. 29, 1953; Eisenhower to Durham, Feb. 14, 1953, both in AEC.
3. Richard G. Hewlett and Francis Duncan, *Atomic Shield, 1947-1952*, Vol. II of *A History of the U.S. Atomic Energy Commission* (University Park: Pennsylvania State University Press, 1969), pp. 369-408 (hereafter cited *Atomic Shield*).
4. *Ibid.*, pp. 438-39, 529-41, 554-56, 569-71.
5. Joint Committee on Atomic Energy, Transcript of Hearing on Status of Atomic Energy Program, Feb. 6, 1952, AEC.
6. Joint Committee on Atomic Energy, Transcript of Hearing on Status of Hydrogen Project, Feb. 21, 1952, AEC.
7. R. A. Lovett to McMahon, March 9, 1952, AEC.
8. Foster to Acheson and Dean, March 28, 1952; Secretaries of Army, Navy, and Air Force to Secretary of Defense, March 27, 1952; Dean to Files, April 1, 1952, all in AEC.
9. Minutes, 30th Meeting of the General Advisory Committee, April 27-29, 1952, AEC (hereafter cited GAC 30).
10. Bethe to Dean, May 28, 1952, with attachment, Bethe to Dean, May 23, 1952; Teller to Garrison Norton, Aug. 15, 1952, transmitting comments on Bethe's history, both in AEC.
11. C. A. Rolander and R. Robb, Informal Interview with William L. Borden, Feb. 20, 1954, AEC.
12. Wheeler, Statement on Loss of Classified Document, March 3, 1953, AEC.
13. Joint Committee on Atomic Energy, Policy and Progress in the H-Bomb Program: A Chronology of Leading Events, Jan. 1, 1953, JCAE.
14. No copy of the Walker document was found in AEC files. Description of the

- contents has been reconstructed from various reports and correspondence on the incident, e.g., Bethe, Bradbury, Teller, and von Neumann to the Commissioners, March 2, 1953, AEC.
15. Hoover to Waters, Jan. 9, 1953, AEC.
 16. Chronology of Missing Document, AEC 634/1, April 16, 1953; Waters to File, Feb. 4, 1953, both in AEC.
 17. Murray, Meeting with Eisenhower, Feb. 16, 1953, TEM.
 18. Atomic Energy Act of 1946, P.L. 585, 79 Cong., 60 Stat. 755-75, 42 U.S.C., 1801-19, Sect. 15 (b).
 19. National Security Council, Summary of Discussion (hereafter cited SNSC), Meeting 132, Feb. 18, 1953, DDE.
 20. *Public Papers, 1953, Eisenhower*, pp. 40-41; *New York Times*, Feb. 12, 1953, p. 1. In late 1952 the Rosenberg case had suddenly become an international cause célèbre. Simultaneously the Supreme Court refused to review the case, leaving presidential clemency the Rosenbergs' only hope. See Ronald Radosh and Joyce Milton, *The Rosenberg File: A Search for the Truth* (New York: Holt, Rinehart, and Winston, 1983), pp. 330, 335, 347-49 (hereafter cited Radosh and Milton, *The Rosenberg File*).
 21. The value of the data the Rosenbergs allegedly passed on is examined in Radosh and Milton, *The Rosenberg File*, pp. 432-49, and Roger M. Anders, "The Rosenberg Case Revisited: The Green-glass Testimony and the Protection of Atomic Secrets," *American Historical Review* 83 (April 1978): 388-400. Durham to Eisenhower, Jan. 29, 1953; Eisenhower to Durham, Feb. 14, 1953, both in AEC.
 22. Department of State, Panel of Consultants on Disarmament, Arms and American Policy, second run, Jan. 1953, DOS.
 23. SNSC 132, Feb. 18, 1953, DDE.
 24. SNSC 133, Feb. 25, 1953, DDE; Dean Diary, Feb. 24, 1953, AEC.
 25. John Major, *The Oppenheimer Hearing* (London: B. T. Batsford, 1971), p. 252 (hereafter cited Major, *The Oppenheimer Hearing*).
 26. Borden to Strauss, Sept. 10, 20, 1952, LLS.
 27. Philip M. Stern, *The Oppenheimer Case: Security on Trial* (New York: Harper & Row, 1969), p. 169 (hereafter cited Stern, *The Oppenheimer Case*); Joint Committee Working Paper, Nov. 3, 1952, AEC.
 28. Stern, *The Oppenheimer Case*, pp. 102-103; *Atomic Shield*, pp. 13-14.
 29. Lewis L. Strauss, *Men and Decisions* (Garden City, NY: Doubleday, 1962), pp. 270-74 (hereafter cited Strauss, *Men and Decisions*).
 30. Drew Pearson, *Newark Star Ledger*, April 20, 1954; Joseph and Stewart Alsop, *We Accuse!* (New York: Simon & Schuster, 1954), p. 7; Stern, *The Oppenheimer Case*, pp. 128-30; Joint Committee on Atomic Energy, *Hearings on an Investigation into the United States Atomic Energy Project* (Washington: Government Printing Office, 1949), pp. 277-315.
 31. Stern, *The Oppenheimer Case*, pp. 178, 190-91, 204-05; D. M. Ladd to Director, FBI, Jan. 23, 1952; Hoover to Sidney W. Souers, March 26, 1952; L. B. Nichols to Mr. Tolson, March 28, 1952; Hoover to Souers, May 19, 1952; W. A. Branigan to A. H. Belmont, June 10, 1952, all in FBI; Major, *The Oppenheimer Hearing*, pp. 263-64.
 32. Dean Diary, Nov. 24, 26, Dec. 1, 4, 1952, AEC; *Atomic Shield*, p. 519. Cotter sent Borden two memos on the Weinberg case, Dec. 2 and Dec. 8, 1952, JCAE. For Borden's interest in Oppenheimer's Berkeley activities, see Borden to E. O. Lawrence, Dec. 23, 1952, Jan. 13, 1953, and Borden to File, Jan. 17, 1953, all in AEC.
 33. Joint Committee Working Paper, Nov. 3, 1952, JCAE; Hoover to Dean with FBI report on Wheeler incident, March 11, 1953; Transcript of Dean's testimony before the Joint Committee, March 24, 1953; Cole to the Attorney General, undated but about April 20, 1953; Cole to Dean, April 27, 1953, all in AEC 634/5, May 5, 1953; Attorney General to Dean, March 11, 1953, in AEC 634, March 24, 1953; Dean to Attorney General, April 3, 1953, all in AEC.
 34. Strauss Telephone Log, April 28, 1953; Strauss Appointment Calendar, April 30, 1953, both in AEC. On April 28, Strauss talked with Trevor Gardner, Ernest Lawrence, Kenneth D. Nichols, Kenneth S. Pitzer, Luis Alvarez, and Leslie R. Groves.
 35. "The Hidden Struggle for the H-Bomb," *Fortune* 47 (May 1953): 109-10, 230.
 36. The Air Force's effort to remove Oppenheimer's influence over national military

- policy has been extensively described, first in the Oppenheimer Hearings and more recently in secondary sources. See U.S. Atomic Energy Commission, *In the Matter of J. Robert Oppenheimer: Transcript of Hearing Before Personnel Security Board* (Washington: Government Printing Office, 1954), pp. 681-85, 744-54; Stern, *The Oppenheimer Case*, pp. 178-98; Major, *The Oppenheimer Hearing*, pp. 238-63.
37. The four were Ellis M. Zacharias, Oppenheimer, Isidor I. Rabi, and Charles C. Lauritsen. The FBI later tried to run down the source of the ZORC story. SAC, Newark, to Director, FBI, April 3, 1954; Branigan to Belmont, June 3, 1954; Hoover to Waters, June 4, 18, 1954; FBI Investigative Report, June 21, 1954, all in FBI.
 38. Nichols to Tolson, May 11, 1953, and Hoover to Tolson et al., May 19, 1953, both in FBI.
 39. Robert A. Divine, *Eisenhower and the Cold War* (New York: Oxford University Press, 1981), pp. 106-8; *Public Papers, 1953, Eisenhower*, pp. 179-84; NSC 151, Armaments and American Policy, May 8, 1953, AEC.
 40. Waters to File, May 14, 1953, AEC.
 41. Joint Committee Working Paper, May 29, 1953, AEC.
 42. Ladd to Hoover, May 25, 1953, FBI.
 43. R. B. to Mr. Stevens, May 18, 1953, President's Personal File, DDE.
 44. R. W. Kirkman, director of AEC security at New York, to Waters, May 26, 1953, with encl., Oppenheimer to Mr. Marin, May 19, 1953, AEC.
 45. SNSC 146, May 27, 1953, DDE; Lay to Dean, May 29, 1953, AEC.
 46. Belmont to Ladd, June 5, 1953, FBI.
 47. Dean Diary, June 5, 1953; W. J. Williams Diary, June 5, 1953; AEC Contract AT (49-1)-805, Mod. 1, June 5, 1953, all in AEC; Strauss, *Men and Decisions*, p. 275.
 48. Edmund A. Gullion of the State Department began working on drafts of the speech in June. His first, third, and fifth drafts, dated June 16, 22, and July 17, 1953, are in DDE. James H. Lambie of the White House staff handled day-to-day contacts with the Advertising Council. See Lambie to Adams, July 9, 1953; Lambie to Cutler, July 29, 1953, both in DDE; Jackson to T. S. Repplier, president of the Advertising Council, June 4, 1953; Jackson to Cutler, June 24, 1953; Cutler to Dean, June 26, 1953; Cutler to Jackson, July 20, 1953, all in DDE.
 49. See statement by Jules Halpern, chairman, Federation of American Scientists, *Bulletin of the Atomic Scientists* 8 (Dec. 1952): 299.
 50. J. R. Oppenheimer, "Atomic Weapons and American Policy," *Foreign Affairs* 31 (July 1953): 525-35.
 51. Joint Task Force 132, Film on Operation IVY, uncut version, AEC.
 52. Dean Diary, May 21, 22, 25, 29, June 1, 2, 1953; Cutler to the Commissioners, May 29, 1953, all in AEC.
 53. Dean, Press Conference, June 25, 1953, AEC; *Christian Science Monitor*, June 27, July 1, 1953; *Washington Post*, June 19, 1953, p. 4; *New York Times*, June 19, 1953; *Los Angeles Times*, July 3, 1953; *Wall Street Journal*, June 30, July 1, 1953; *Memphis Commercial Appeal*, Aug. 7, 1953.
 54. *Public Papers, 1953, Eisenhower*, p. 476. The Commissioners were given a copy of the transcript in AEC 111/26, July 16, 1953. *Washington Post*, June 27, 1953, p. 8.
 55. Smyth, Analysis of Secrecy, AEC 111/25, June 17, 1953, AEC.
 56. CM 889, July 17, 1953; CM 897, July 28, 1953, both in AEC.
 57. Wiley to Strauss, Aug. 7, 1953, in AEC 111/30, Aug. 17, 1953; Strauss to Wiley, Aug. 19, 1953, in AEC 111/32, Aug. 24, 1953, both in AEC.
 58. CM 887, July 14, 1953; CM 892, July 22, 1953; CM 894, July 24, 1953; CM 896, July 27, 1953; CM 898, July 29, 1953; CM 902, Aug. 5, 1953; CM 904, Aug. 13, 1953, all in AEC.
 59. Strauss Telephone Log, May 25, 29, June 23, July 16, 1953; Strauss Appointment Calendar, June 23, July 10, July 23, 1953, both in AEC; Murphy, "The Atom and the Balance of Power," *Fortune* 48 (August 1953): 97, 202.
 60. Jackson to Strauss, Aug. 5, 1953; C. D. Jackson Logs, Aug. 4, 1953, both in CDJ.
 61. The full text of Malenkov's speech appeared in the *New York Times*, Aug. 10, 1953, p. 6. AEC Press Release 494, Aug. 8, 1953, AEC.
 62. Draft press announcements, Aug. 14, 1953, AEC.

63. Strauss, Memo Files, Aug. 19, 1953; AEC Press Release 495, Aug. 20, 1953, both in AEC. The headline appeared in the *New York Journal-American*, Aug. 20, 1953. Similar headlines appeared in the *Washington Post* and *Washington Times-Herald*, Aug. 20, 1953. The *New York Times* carried a page-one feature story but no headline. C. D. Jackson Logs, Aug. 14-16, 1953, CDJ. The text of the Soviet announcement appeared in the *Washington Evening Star* and other papers on Aug. 20, 1953.
64. Cole to Eisenhower, Aug. 21, 1953, AEC; *New York Times*, Aug. 21, 1953, p. 1. Articles containing excerpts from Cole's American Legion speech appeared in the *New York Herald-Tribune* and many other papers on Oct. 13, 1953. Strauss's concern, expressed in MLC 84, Aug. 27, 1953, AEC, was confirmed many years later by Andrei Sakharov in an article quoted by Herbert F. York, *Oppenheimer, Teller, and the Superbomb* (New York: Norton, 1975), pp. 101-3. For Eisenhower's statement, see *Public Papers, 1953, Eisenhower*, p. 617.
65. American analyses of Joe 4 appear in Carson Mark to John von Neumann, Sept. 4, 1953; Strauss to Cole, Oct. 27, 1953; Bethe, Summary of Preliminary Findings, Dec. 26, 1953; von Neumann to Cole, Nov. 23, 1953; Bethe to Strauss, Dec. 30, 1953, all in AEC. On the Commissioners' lack of information, see Zuckert to Strauss, Sept. 22, 1953, AEC.
66. Eisenhower to Jackson, Aug. 24, 1953; Jackson to R. G. Arneson, Sept. 2, 1953; John A. DeChant to Jackson, Sept. 3, 1953, all in DDE. See also Sherman Adams, *Firsthand Report: The Story of the Eisenhower Administration* (New York: Harper, 1961), pp. 109-10; Robert J. Donovan, *Eisenhower: The Inside Story* (New York: Harper, 1956), pp. 184-85 (hereafter cited Donovan, *Eisenhower*).
67. Cutler to Jackson, Sept. 3, 1953; Safety of the Republic, Sept. 9, 1953, both in DDE. A transcript of the June 3, 1953, television report is in *Public Papers, 1953, Eisenhower*, pp. 363-76.
68. Abbott Washburn to Jackson, Sept. 14, 1953, DDE.
69. Lambie to Arneson et al., Sept. 28, 1953, DDE; James Reston in the *New York Times*, Sept. 23, 1953, presented a detailed and essentially accurate story of *Candor*. Arthur Krock in the *New York Times*, Oct. 8, 1953; Strauss, Remarks for National Security Industrial Association, New York City, Sept. 30, 1953; Strauss to the Commissioners, Oct. 6, 1953, both in AEC; *New York Times*, Review of the Week, Oct. 11, 1953; *Newsweek*, Sept. 28, 1953, p. 28; Wilson, Excerpts from Press Conference, Sept. 29, 1953, p. 2, AEC.
70. SNSC 165, Oct. 7, 1953, DDE; Strauss to Eisenhower, Oct. 7, 1953; Lay to NSC, Oct. 8, 1953, both in AEC.
71. Hickenlooper's statement was reported in the *Baltimore Sun*, Oct. 5, 1953; President's News Conference, Oct. 8, 1953, in *Public Papers, 1953, Eisenhower*, pp. 644-48.
72. No copy of the Sept. 10 memo from Cutler to Jackson and Strauss was found in DDE, CDJ, or AEC. The memorandum is quoted in Strauss, *Men and Decisions*, p. 357, and Donovan, *Eisenhower*, pp. 185-86.
73. Stern, *The Oppenheimer Case*, pp. 204-5.
74. Hoover to Tolson and Ladd, June 24, 1953, FBI.
75. Murray Diary Memo, June 9, Aug. 18, 1953, TEM; Waters to Strauss, May 12, 1954; W. J. Williams Diary, Aug. 31, 1953, both in AEC; Ladd to Belmont, Aug. 28, 1953, FBI.
76. Belmont to Ladd, Sept. 10, 1953; Director, FBI, to SAC, Field, Sept. 14, 1953, both in FBI.
77. John Luter, Oral History Interview with Nichols, Oct. 12, 1967, DDE; Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946, Vol. 1 of A History of the U.S. Atomic Energy Commission* (University Park: Pennsylvania State University Press, 1962), pp. 649-50, 653.
78. Murray Diary Memo, Sept. 2, 1953, TEM.
79. CM 1007, June 15, 1954, AEC.
80. Strauss, *Men and Decisions*, pp. 357-58. For the development of Atoms for Peace from the President's perspective, see Stephen E. Ambrose, *Eisenhower, the President* (New York: Simon & Schuster, 1984), pp. 131-53.
81. Donovan, *Eisenhower*, pp. 186-87, refers to several documents that have not been found in DDE, CDJ, or AEC. The first draft of the Strauss memorandum,

- dated Oct. 26, 1953, is in DDE; the second draft with a letter to Jackson, Nov. 6, 1953, is in CDJ.
82. Dulles to Cutler, Oct. 13, 1953, with State Department draft, "For Second Half of Atomic Speech"; Summary of Discussion of State Draft, Oct. 19, 1953, both in CDJ.
83. Copies of the five drafts, dated Nov. 3, 5, 22, 28, and Dec. 1, 1953, are in DDE. See also Jackson to Emmit Hughes, Nov. 6, 1953; Jackson to Strauss, Nov. 28, 1953, both in DDE, and C. D. Jackson Logs, Nov. 30, Dec. 3, 1953, CDJ.
84. Borden to Nichols, Nov. 7, 1953; Borden to Hoover, Nov. 7, 1953, both in FBI.
85. Belmont to Ladd, Nov. 19, 1953, FBI.
86. Murray Diary Memo, Nov. 23, 1953, TEM.
87. C. D. Jackson Logs, Nov. 27, 1953, CDJ.
88. Ibid., Dec. 2, 1953, CDJ.
89. Hoover to Tolson, Ladd, and Nichols, 9:22 a.m., Dec. 2, 1953, FBI.
90. Dwight D. Eisenhower, *Mandate for Change, 1953-1956* (New York: Doubleday, 1963), pp. 310-11 (hereafter cited Eisenhower, *Mandate for Change*).
91. Strauss incorrectly records his late afternoon visit to the White House as being on Dec. 3, not Dec. 2. The Dec. 3 date would suggest that the decision had been made before Strauss arrived. In fact, the evidence indicates that Eisenhower discussed his intentions with Strauss and others on Dec. 2 and made the decision the same day. Strauss, *Men and Decisions*, p. 267; Eisenhower, *Mandate for Change*, p. 311; Stern, *The Oppenheimer Case*, p. 220; Strauss Appointment Calendar, Dec. 2, 3, 1953; W. H. Haggard to R. M. Anders, Nov. 12, 1974, with encl., National Oceanic and Atmospheric Admin., Local Climatological Data, Washington, D.C., Dec. 2, 3, 1953, both in AEC; Anne C. Whitman, Memo for the Secretary of State, Dec. 3, 1953, Brownell Folder, DDE; Hoover to Tolson, Ladd, Nichols, and Belmont, Dec. 4, 1953, FBI.
92. Hoover to Tolson, Ladd, and Belmont, 4:52 p.m., Dec. 3, 1953; Hoover to Tolson, Ladd, and Nichols, 5:58 p.m., Dec. 3, 1953, both in FBI. Borden was interviewed in Pittsburgh on the evening of Dec. 3. In a telex to FBI headquarters early on the morning of Dec. 4, the special agent reported that he found Borden "quite intelligent, extremely verbose and inclined toward generalities rather than specifics." Hallford to Inspector Carl E. Hennrich, Dec. 4, 1953, FBI.
93. Hoover to Tolson, Ladd, and Nichols, 4:26 p.m., Dec. 3, 1953; Hoover to Tolson, Ladd, Belmont, and Nichols, Dec. 14, 1954, both in FBI; Bryan LaPlante, Diary Memo, Dec. 3, 1953; Strauss to General Manager, Dec. 3, 1953, both in AEC.
94. Luter, Nichols Interview, Oct. 12, 1967, DDE.
95. Eisenhower, *Mandate for Change*, pp. 310-11; C. D. Jackson Logs, Nov. 27-Dec. 2, 1953, CDJ; Major, *The Oppenheimer Hearing*, pp. 267-69.
96. C. D. Jackson Logs, Dec. 3, 1953, CDJ.
97. Dulles, Memorandum of Conversation with Churchill, Dec. 5, 1953, DDE; Donovan, *Eisenhower*, pp. 188-89; Strauss, *Men and Decisions*, pp. 358-59; J. M. Dunford to Murray, Dec. 18, 1953, TEM.
98. Bermuda Draft #3, Dec. 7, 1953, edited on the airplane, is in CDJ. See also first version of stenciled copy, Dec. 8, 1953, with handwritten notes by the President, in CDJ.
99. The final version of the speech appears in *Public Papers, 1953, Eisenhower*, pp. 813-22.
100. Ibid., p. 820. On reactions to the speech, see Henry Cabot Lodge to Jackson, Dec. 10, 1953, enclosing Summary of Reactions to President Eisenhower's Speech, Dec. 9, 1953, DDE.

CHAPTER FOUR

1. Richard G. Hewlett and Francis Duncan, *Atomic Shield, 1947-1952*, Vol. II of *A History of the U.S. Atomic Energy Commission* (University Park: Pennsylvania State University Press, 1969), pp. 332-34 (hereafter cited *Atomic Shield*); Walter Gellhorn, *Security, Loyalty, and Science* (Ithaca, NY: Cornell University Press, 1950); Eleanor Bontecou, *The Federal Loyalty-Security Program* (Ithaca, NY: Cornell University Press, 1953); New York Bar Association, *The Federal Loyalty-Security Program* (New York: Dodd, Mead, 1956).

2. Henry D. Smyth, Answers to Questions in Stern Letter, Aug. 7, 1967; Mary Smyth Diary, Dec. 2-26, 1953, both in HDS.
3. Murray to Strauss, Dec. 10, 1953, TEM; page 2 was not provided.
4. Murray to Strauss, Dec. 7, 1953, AEC.
5. Murray Diary Memo, Dec. 8, 9, 1953; TEM.
6. Ibid., Dec. 10, 1953, TEM.
7. LaPlante, Implementation of the President's Directive, entry for Dec. 9, 1953; Strauss Appointment Calendar, Dec. 9-10, 1953, all in AEC.
8. Murray Diary Memo, Dec. 10, 1953, TEM.
9. AEC Press Release 470, Feb 18, 1953, AEC; Belmont to Ladd, Dec. 10, 12, 1953, FBI.
10. Philip M. Stern, *The Oppenheimer Case: Security on Trial* (New York: Harper & Row, 1969), pp. 225-26 (hereafter cited Stern, *The Oppenheimer Case*).
11. Hoover to Strauss, Nov. 27, 1953, FBI.
12. Stern, *The Oppenheimer Case*, p. 226.
13. Ibid., pp. 227-28; John Major, *The Oppenheimer Hearing* (London: B. T. Batsford, 1971), pp. 270-71 (hereafter cited Major, *The Oppenheimer Hearing*).
14. Hoover to Strauss, Dec. 18, 1953; Belmont to Ladd, Dec. 17, 18, 21, 1953, all in FBI.
15. Belmont to Ladd, Dec. 18, 1953, FBI.
16. Hoover to Tolson et al., Dec. 14, 15, 1953, FBI; Murray Diary Memo on Executive Session, Dec. 15, 1953, TEM.
17. Murray Diary Memo, Dec. 15, 16, 1953, TEM.
18. Nichols, Meeting with Oppenheimer, Dec. 21, 1953, AEC; Belmont to Ladd, Dec. 21, 1953, FBI. Nichols's memorandum, on which this account is based, does not square in all respects with the version presented in Stern, *The Oppenheimer Case*, pp. 229-31. Executive Order 10450, Security Requirements for Government Employment, April 27, 1953; Athan Theoharis, *Spying on Americans: Political Surveillance from Hoover to the Huston Plan* (Philadelphia: Temple University Press, 1978), pp. 210-18.
19. Oppenheimer claimed that Strauss first raised the possibility of resignation in U.S. Atomic Energy Commission, *In the Matter of J. Robert Oppenheimer: Transcript of Hearings Before Personnel Security Board* (Washington: Government Printing Office, 1954), p. 22 (hereafter cited *Hearings*). Nichols stated in his Dec. 21 memorandum that it was Oppenheimer. The disagreement seems trivial because Strauss had promised the Commissioners that he would raise the question in any event.
20. Nichols, Meeting with Oppenheimer, Dec. 21, 1953; CM 999, June 7, 1954, both in AEC; Lewis L. Strauss, *Men and Decisions* (Garden City, NY: Doubleday, 1962), pp. 276-78.
21. Strauss told Bates that he thought Oppenheimer really wanted to drop the matter quietly but was persuaded by his attorneys, Volpe and Marks, to ask for a hearing. Strauss suspected that their motive was lucrative legal fees. Belmont to Ladd, Dec. 23, 1953, FBI.
22. C. C. Hennrich to Belmont, Dec. 15, 1953; Ladd to Hoover, Dec. 21, 1953; Belmont to Ladd, Dec. 24, 1953; SAC, Newark, to Hoover, Jan. 5, 1954, all in FBI.
23. Belmont to Ladd, Jan. 5, 26, 28, 1954, all in FBI.
24. FBI, Newark, to Director, FBI, Jan. 5, 1954; Hoover to Strauss, Jan. 26, Feb. 1, 1954, all in FBI; Stern, *The Oppenheimer Case*, p. 241. Allen B. Ecker also joined Oppenheimer's legal staff before the hearings opened.
25. Garrison to Nichols, Jan. 20, 1954; Rolander to Nichols, Jan. 21, 1954; Rolander to File, Jan. 26, 1954, all in AEC.
26. Mitchell to File, Feb. 15, 1954; Nichols to Garrison, Feb. 12, 1954, both in AEC.
27. Mitchell to File, Jan. 19, 1954; Nichols, Memo for Record, Jan. 19, 1954; Garrison to Nichols, Jan. 20, 1954, all in AEC.
28. Mitchell to File, March 15, 1954, AEC.
29. Mitchell to Nichols, Jan. 12, 1954, AEC.
30. Mitchell to Morgan, March 9, 1954, AEC; Belmont to Ladd, Feb. 26, 1954, FBI.
31. Belmont to Ladd, Jan. 15, 1954; Hoover to Tolson et al., Feb. 1, 5, 1954, all in FBI; Joseph and Stewart Alsop, *We Accuse!* (New York: Simon & Schuster, 1954), p. 7. The Alsops neglected to mention that Robb had also served as a court-appointed attorney for Communist party leader Earl Browder.
32. It is interesting to note that when Drew Pearson charged that Strauss was primar-

- ily responsible for instigating the investigation and hearings against Oppenheimer, he omitted any reference to Robb. Most likely Pearson had never heard of Robb either or, if he had, did not regard his appointment as significant. Drew Pearson, *Washington Post* and *Times-Herald*, April 20, 1954.
33. CM 962, Feb. 17, 1954, AEC.
34. A list of FBI reports sent to the Commission is attached to Virginia H. Walker to Harry S. Traynor, March 7, 1960, AEC. Most of these reports are available in FBI.
35. Worried about the propriety of providing Robb with such information, Strauss wrote Rolander: "I understand that you contemplate reproducing communications which I have received from the Federal Bureau of Investigation. This must not be done without the knowledge and consent of the Bureau, and I shall assume that unless I hear to the contrary, you have obtained this permission." Strauss to Rolander, March 9, 1954, AEC. No memorandum to the contrary was found in the files. Results of the telephone taps were reported daily to Washington. For example, see SAC, Newark to Director, FBI, February 24, March 1, March 25, 1954, all in FBI. For examples of surveillances while Oppenheimer was traveling, see FBI report on Rochester trip, Feb. 23, 1954; FBI Wash Field to Director, FBI, March 3, 1954; FBI Boston to Director, FBI, March 8, 1954, all in FBI.
36. During February and March 1954 Hoover sent Strauss up to three daily reports on the Oppenheimer case; copies are in FBI. See especially Hoover to Strauss, Feb. 18, March 3, 11, 16, 19, 25, 1954, all in FBI.
37. Rolander to File, Feb. 16, 1954; Rolander to Bates, Feb. 17, 18, 19, 1954, all in AEC; Belmont to Ladd, Feb. 2, 1954; Belmont to L. V. Boardman, March 29, 1954; Branigan to Belmont, March 31, 1954, all in FBI.
38. Rolander to File, Feb. 16, 1954; Rolander to Bates, March 1, 1954, both in AEC; Hoover to Strauss, Jan. 22, April 19, 1954, both in FBI.
39. Belmont to Boardman, April 6, 1954, *FBI*; Rolander-Robb-Borden interview, Feb. 20, 1954, AEC. Borden also supplied a list to the FBI bringing the total to about thirty-eight.
40. Rolander to File, Feb. 25, March 15, 22, 1954, all in AEC; *Hearings*, pp. 178-79, 266-70.
41. Rolander to File, March 15, 18, 1954, AEC.
42. Murray Diary Memo, Jan. 29, 1954, TEM.
43. E. R. Trapnell to Strauss, Oct. 26, 1953, AEC.
44. Belmont to Boardman, April 11, 1954, FBI; Major, *The Oppenheimer Hearing*, p. 9.
45. Stern, *The Oppenheimer Case*, pp. 243-44.
46. Hagerty Diaries, April 7-11, 1954, DDE.
47. Oral history interview with Gordon Gray by Robert Hopper, Washington, D.C., March 7, 1967, DDE.
48. Mitchell to File, April 5, 1954; Rolander to File, April 14, 1954; Strauss to Rolander, April 26, 1954, all in AEC. See also *Hearings*, pp. 527-28. Of the scientists mentioned by Gardner, Strauss noted: "In addition to being witnesses, [they] are also active workers on Oppenheimer's team. I think in their records in the future we can't overlook this." Telephone conversation between Strauss and Mitchell, May 10, 1954, AEC; Belmont to Boardman, May 10, 1954, FBI.
49. Rolander to File, April 12, 1954, AEC; Belmont to Boardman, April 24, 1954, FBI.
50. *Hearings*, pp. 565, 53-55; Stern, *The Oppenheimer Case*, pp. 263-64.
51. The Gray board proceedings, published by the Atomic Energy Commission, have been exhaustively analyzed by several scholars, including: Stern, *The Oppenheimer Case*; Major, *The Oppenheimer Hearings*; Charles P. Curtis, *The Oppenheimer Case: The Trial of a Security System* (New York: Simon & Schuster, 1955); Joseph and Stewart Alsop, *We Accuse!* (New York: Simon & Schuster, 1954); Cushing Strout, "The Oppenheimer Case: Melodrama, Tragedy, and Irony," *Virginia Quarterly Review* 40 (Spring 1964): 268-80. This account does not recapitulate the Gray board proceedings in detail.
52. Gray to Mitchell, May 10, 1954, AEC.
53. Dean Diary, Nov. 24, 1952, AEC; *Hearings*, pp. 16-17, 216, 306, 335-36; Branigan to Belmont, May 13, 1954, FBI.
54. *Atomic Shield*, pp. 391-92; U.S. Atomic Energy Commission, *In the Matter of*

J. Robert Oppenheimer: Texts of Principal Documents and Letters of Personnel Security Board, General Manager, Commissioners (Washington: Government Printing Office, 1954), p. 13 (hereafter cited *Principal Documents*); *Hearings*, p. 19.

55. *Hearings*, pp. 679-97, 742-70.
56. Garrison Norton to Finletter, July 1, 1952, AEC. See also *Hearings*, pp. 771-73.
57. Hoover to Waters, April 16, May 19, 1952, AEC. The scientist did not repeat his doubts about Oppenheimer's loyalty to the Gray board. *Hearings*, pp. 697-709.
58. Hoover to Waters, May 19, 1952, FBI; *Hearings*, pp. 328-29.
59. Rolander to File, March 15, 1954, AEC; italics added.
60. *Hearings*, p. 710.
61. *Ibid.*, p. 726; italics added.
62. FBI Field Report, George C. Eltenton, June 28, 1946, FBI.
63. *Ibid.*; FBI Field Report, Eltenton, July 3, 1946, FBI.
64. *Hearings*, pp. 14, 131, 137-39, 146-49, 285-300.
65. Hoover to Strauss, Dec. 18, 1953, FBI; LaPlante, Memo for File, Dec. 17, 1953, AEC; *Hearings*, pp. 167-68.
66. FBI Field Report, Eltenton, June 28, 1946, July 3, 1946, both in FBI.
67. FBI Field Report, Eltenton, Sept. 18, 1946, FBI.
68. *Hearings*, pp. 137-38, 145-46, 887-88.
69. *Ibid.*, p. 263.
70. *Ibid.*, p. 167.
71. Hooper interview with Gray, DDE; Summary of Oppenheimer Hearing, May 29, 1954; Director, FBI to SAC, San Francisco, May 28, 1954; Belmont to Boardman, June 2, 1954, all in FBI.
72. Gray to Nichols, May 27, 1954, in AEC 735, May 28, 1954, AEC.
73. Hooper interview with Gray, DDE.
74. Stern, *The Oppenheimer Case*, pp. 379-82; Major, *The Oppenheimer Hearing*, p. 187; Minority Report of Dr. Ward V. Evans, in AEC 735, May 28, 1954, pp. 34-36, AEC.
75. Mitchell to Nichols, May 20, 1954, AEC. The security clearance procedures in effect at that time had been adopted in September 1950. *Code of Federal Regulations*, Title 10-Atomic Energy, Part 4, Security Clearance Procedures.
76. CM 987, May 18, 1954, AEC.
77. Garrison to Nichols, June 1, 9, 1954; Nichols to Garrison, June 3, 24, 1954; CM 997, June 3, 1954; CM 999, June 7, 1954; CM 1001, June 9, 1954; Rolander to LaPlante, May 3, 1954, all in AEC.
78. Transcript, CM 1007, June 15, 1954, p. 61, AEC. Nichols's recommendation was published in *Principal Documents*, pp. 43-48.
79. Transcript, CM 1008, June 16, 1954, pp. 72-74, 78, AEC.
80. Smyth to the Commissioners, June 21, 1954, AEC.
81. Transcript, CM 1007, June 15, 1954, pp. 66-67, AEC.
82. FBI Field Report, Oppenheimer, Dec. 31, 1953, FBI.
83. Transcript, CM 1008, June 16, 1954, AEC.
84. Transcript, CM 1008, part 2, June 16, 1954, pp. 54-55, AEC. Kenneth E. Fields was the AEC director of military application.
85. Hagerty Diary, June 1, 1954, DDE. For published excerpts from the Hagerty Diary, see Robert H. Ferrell, ed., *The Diary of James C. Hagerty: Eisenhower in Mid-Course, 1954-1955* (Bloomington: Indiana University Press, 1983).
86. Hagerty Diary, May 29, 1954, DDE.
87. *Ibid.*, June 1, 10, 1954, DDE; Belmont to Boardman, June 4, 1954, FBI.
88. Transcript of telephone conversation between Reston and Oppenheimer, June 11, 1954, JRO.
89. Gray to Rolander, June 9, 1954, AEC.
90. CM 1003, June 12, 1954; CM 1004, June 14, 1954; CM 1005, June 14, 1954; CM 1006, June 15, 1954; CM 1007, June 15, 1954; Smyth, Memo to the Commission, June 14, 1954, all in AEC; SAC, Boston, to Director, FBI, June 14, 1954, FBI.
91. Hagerty Diary, June 27, 1954, DDE.
92. CM 1011, June 28, 1954, AEC. All five opinions were published in *Principal Documents*. They were also published in the *New York Times*, June 30, 1954, p. 12.
93. *Hearings*, pp. 54, 365.
94. Ralph E. Lapp, "Atomic Candor," *Bulletin of the Atomic Scientists* 10 (Oct. 1954): 336.
95. Hoover to Strauss, June 18, 1954, FBI; Nichols to R. W. Scott McLeod, June 23, 1954; Warren Olney III to Mitchell, June 25, 1954; Hoover to Strauss, July 20, 1954, all in AEC; Hoover to Waters,

- Aug. 11, 26, 27, 31, 1954, all in FBI; Rolander to Nichols, Aug. 10, 26 (two memoranda), 30, 1954, all in AEC; Hoover to Tolson et al., June 29, 1954; FBI Summary, July 2, 5, 14, 1954; Deputy Director, Plans, CIA, to Director, FBI, July 9, 1954; R. R. Roach to Belmont, July 9, 1954; CIA Memo I-2, Aug. 23, 1954; SAC, Newark, to Director, FBI, August 24, 1954; Belmont to Boardman, Aug. 24, 1954, all in FBI.
96. The letters are on file in AEC.
97. "Scientists Affirm Faith in Oppenheimer," *Bulletin of the Atomic Scientists* 10 (May 1954): 188-91; Bethe to Strauss, June 10, 1954; Merle Burgoyne et al. to Chairman and Commissioners, June 17, 1954; William Robinson to L. J. Ha-
worth, May 12, 1954; William Nelis to Strauss, June 25, 1954; Fred L. Ribe to Eisenhower, June 15, 1954; Arthur H. Snell et al. to the Commissioners, Oct. 11, 1954; Robert Christy et al. to Strauss, June 21, 1954; Sidney Drell to Eisenhower, May 27, 1954; CM 1012, June 30, 1954, all in AEC.
98. *Santa Fe New Mexican*, July 18, 1954.
99. GAC 41, July 15, 1954, AEC.

CHAPTER FIVE

1. James R. Newman and Byron S. Miller, *The Control of Atomic Energy: A Study of Its Social, Economic, and Political Implications* (New York: McGraw-Hill, 1948), p. 19.
2. Arnold Kramish and Eugene M. Zuckert, *Atomic Energy for Your Business: Today's Key to Tomorrow's Profits* (New York: David McKay, 1956), p. 130.
3. See Chap. 2, Nuclear Power and Private Enterprise.
4. General Counsel, Draft Legislation to Encourage Development of Nuclear Power, AEC 615/8, May 11, 1953, AEC. For the final version of the bill, see AEC 615/9, May 21, 1953, AEC.
5. Joint Committee on Atomic Energy, Transcript of Hearing on Nuclear Power Policy, May 26, 1953; Weeks to Dodge, June 23, 1953, in AEC 615/14, June 26, 1953; Excerpts from Executive Agency Comments on Proposed Legislation, AEC 615/11, June 15, 1953, all in AEC.
6. For background and evolution of the AEC position, see Patent Policy in Connection with Industrial Development of Atomic Power, AEC 615/10, June 1, 1953, AEC.
7. CM 872, June 3, 1953; CM 873, June 8, 1953, both in AEC.
8. CM 882, June 26, 1953, AEC.
9. CM 890, July 20, 1953, AEC.
10. Decision Summary on Topnotch II, Sept. 27, 1953; General Counsel, Proposed Legislation to Encourage Development of Peacetime Uses of Atomic Energy, AEC 615/22, Oct. 14, 1953; CM 930, Oct. 21, 1953, all in AEC.
11. The housekeeping amendments included changes in AEC organization and additional provisions for criminal prosecution in matters relating to security. Legislative Proposals by AEC, AEC 495/5, Feb. 24, 1953, AEC.
12. General Counsel, AEC Legislative Program for 1954, AEC 495/9, Sept. 28, 1953; CM 927, Oct. 14, 1953, both in AEC.
13. Richard G. Hewlett and Francis Duncan, *Atomic Shield, 1947-1952*, Vol. II of *A History of the U.S. Atomic Energy Commission* (University Park: Pennsylvania State University Press, 1969), pp. 283-314.
14. Strauss to Eisenhower, Robert LeBaron, and Dodge, separate letters with attachments, all dated Nov. 18, 1953, in AEC 495/11, Nov. 20, 1953, AEC.
15. General Counsel, Clearance of Atomic Power Legislation for White House, AEC 615/29, Dec. 7, 1953; General Counsel, Atomic Power Legislation, AEC 615/30, Dec. 9, 1953; CM 945, Dec. 10, 1953, all in AEC.
16. Draft Message on Amendments to the Atomic Energy Act, Feb. 3, 1954, AEC. Eisenhower's message appears in *Public Papers of the Presidents of the United States, 1954: Dwight D. Eisenhower* (Washington: Government Printing Office, 1960), pp. 260-69 (hereafter cited *Public Papers, 1954, Eisenhower*). Nuclear references in the State of the Union and budget messages are in *ibid.*, pp. 10, 128-30.
17. The portions used almost verbatim are Sections 308(b) and 312(a) of the Communications Act of 1934, P.L.416, 73 Cong., 2 sess.
18. The preceding paragraphs are based in part on Cole's later description of these events, *Congressional Record*, 83 Cong., 2 sess., 1954, p. 11021 (hereafter cited *CR*); Harold P. Green and Alan Rosen-

- thal, *Government of the Atom* (New York: Atherton Press, Prentice Hall, 1963), pp. 124-26; Corbin Allardice and Edward R. Trapnell, *The Atomic Energy Commission* (New York: Praeger, 1974), pp. x, 44-45.
19. The bill was published as "A Proposed Act to Amend the Atomic Energy Act of 1946," Joint Committee on Atomic Energy, Joint Committee Print, 83 Cong., 2 sess. (Washington: Government Printing Office, 1954). The bill was introduced in the House as H.R. 8862 and in the Senate as S. 3323 on April 15 and 19, 1954. All three documents were later published in AEC, *Legislative History of the Atomic Energy Act of 1954* (Washington: Government Printing Office, 1955), pp. 53-255 (hereafter cited *Legislative History*).
 20. Joint Committee on Atomic Energy, Transcript of Hearing, May 3, 1954, pp. 14-33, 48-51, 58-62, AEC.
 21. Mitchell to Strauss, Jan. 14, 1954; Strauss to Brownell, Jan. 18, 1954; Rogers to Strauss, Jan. 29, 1954; Murray to Mitchell, April 30, 1954; Mitchell to File, May 3, 1954; Mitchell to Murray, May 2, 5, 1954, all in AEC.
 22. Joint Committee on Atomic Energy, Transcript of Hearing, May 3, 1954, pp. 84-98, AEC.
 23. *Ibid.*, pp. 105-110B.
 24. *Ibid.*, pp. 111-75.
 25. *Ibid.*, May 4, 1954, pp. 315-16, 356-73.
 26. *Ibid.*, pp. 316, 375-78.
 27. Joint Committee on Atomic Energy, *Hearings on S. 3323 and H.R. 8862, To Amend the Atomic Energy Act of 1946*, (Part I) May 10-19, 1954, Joint Committee Print, 83 Cong., 2 sess. (Washington: Government Printing Office, 1954), pp. 25-46, 58-60, 225-26, 326-29, 375-78, 421-22, 524-25, 537 (hereafter cited *Joint Committee Hearings*).
 28. *Ibid.*, pp. 61, 92, 170-74, 176-78, 218-21, 271-74, 306-21, 334-37, 401, 441, 467.
 29. Joint Committee on Atomic Energy, Transcript of Hearing on Presentation of Casper Ooms, May 5, 1954, pp. 17-18, AEC.
 30. *Joint Committee Hearings* (Part II), June 2-18, 1954, pp. 872-76.
 31. *Public Papers of the Presidents of the United States, 1953: Dwight D. Eisenhower* (Washington: Government Printing Office, 1960), pp. 395-97, 433-34.
 32. Aaron Wildavsky, *Dixon-Yates: A Study in Power Politics* (New Haven: Yale University Press, 1962), pp. 31-33 (hereafter cited Wildavsky, *Dixon-Yates*). This section relies heavily on Wildavsky's analysis and on the published documents cited in his footnotes, which should be consulted for a detailed study of the subject. The following notes contain only representative citations of the published documents to give the reader a sense of the documentation.
 33. Wildavsky, *Dixon-Yates*, pp. 34-38; BOB Chronology, reproduced in Joint Committee on Atomic Energy, *Hearings on Exercise of Statutory Requirements Under Section 164, Atomic Energy Act of 1954*, November 4-13, 1954 (Washington: Government Printing Office, 1954), pp. 814-15 (hereafter cited *Section 164 Hearings*); *Public Papers, 1954, Eisenhower*, p. 169.
 34. Wildavsky, *Dixon-Yates*, pp. 41-49; AEC Chronology, reproduced in *Section 164 Hearings*, pp. 922-25. See p. 280 for Murray's testimony. On the Commission's discussion of Strauss's role, see Notes on Executive Session, Jan. 19, 1954, AEC.
 35. In summer 1953 Strauss had opposed an industrial reactor development contract with TVA on the grounds that it was inconsistent with Administration policy. CM 903, Aug. 6, 1953, and CM 906, Aug. 20, 1953, both in AEC.
 36. Wildavsky, *Dixon-Yates*, pp. 50-64. The original Dixon-Yates proposal, dated Feb. 25, 1954, and the Commission's analysis, Strauss to Dodge, March 3, 1954, are in AEC 385/26, March 5, 1954, AEC. The documents also appear in *Section 164 Hearings*, pp. 931-35. See also Notes on Executive Session, March 2, 1954, and Snapp to Files, March 17, 1954, both in AEC.
 37. Wildavsky, *Dixon-Yates*, pp. 65-78; CM 976, April 14, 1954; Strauss to Dodge, April 15, 1954, both in AEC. The letter is also in *Section 164 Hearings*, pp. 940-43.
 38. Smyth and Zuckert to Hughes, April 16, 1954, AEC. Also appears in *Section 164 Hearings*, pp. 943-44.
 39. Wildavsky, *Dixon-Yates*, pp. 85-86; CR, pp. 5370-72; Nichols to Leverett Saltonstall, April 17, 1954, in *Section 164 Hearings*, p. 827.
 40. *Joint Committee Hearings* (Part II), June

- 2-18, 1954, pp. 760-61, 871-73, 945-65, 1004-7, 1034-37, 1041-42.
41. *Ibid.*, pp. 945-1122.
42. The bill, introduced as H.R.9757 and S.3690, appears in *Legislative History*, pp. 541-748. The Joint Committee report on the bill appeared as Senate Report 1699 and H.R. Report 2181, 83 Cong., 2 sess. The reports are reproduced in *Legislative History*, pp. 749-886, 997-1134. For reasons of brevity we have not followed revisions of the April draft through the May 21, 1954, committee print of H.R.8862 to H.R.9757. The May 21 print appears in *Legislative History*, pp. 257-350. Bricker later explained the background of his suggested changes in *CR*, pp. 10088-93.
43. Holifield expressed his views on several occasions. The most complete exposition of his argument is in *CR*, pp. 10691-93. On Strauss's position, see Chap. 8, *Worldwide Reactions and Atoms for Peace: With or Without the Russians*.
44. Revised Section 11(c) in the Commission's bill was used by the Joint Committee. The Commission draft appears in AEC 495/14, April 8, 1954, AEC.
45. Max Isenbergh to W. B. Holton, May 10, 1954; Isenbergh to Mitchell, May 18, 1954; Isenbergh to H. L. Price, May 25, 1954; R. A. Anderson to Ooms, May 26, 1954; General Counsel, Proposed Patent Provisions As Suggested by Casper Ooms, AEC 495/26, June 9, 1954; CM 1001, June 9, 1954, all in AEC.
46. *New York Times*, June 23, 1954, p. 12; June 25, 1954, p. 6; July 9, 1954, p. 1; Gerard C. Smith, Note re: Discussion with Adm. Strauss, May 20, 1954, DOS; *CR*, pp. 8060-61, 11030-31, 11165-72.
47. *CR*, pp. 9247, 9251-58, 9556-57, 9924-25, 9928-48.
48. Wildavsky, *Dixon-Yates*, pp. 101-3.
49. *CR*, pp. 10017-18, 10109-12, 10158-202, 10210-21; *New York Times*, July 15, 1954, p. 1; July 17, 1954, p. 1.
50. *CR*, pp. 10231-37, 10252-62, 10278-94, 10584-96, 10615-17, 10715-66; *New York Times*, July 19, 20, 21, 1954, all front-page stories.
51. Eleven Democrats joined the Republicans in voting for the Ferguson amendment. Only two Republicans, Cooper of Kentucky and Langer of North Dakota, voted against the amendment. *CR*, pp. 10770-72, 10783-88; *New York Times*, July 22, 1954, p. 1.
52. *CR*, pp. 10864-93, 10898-926, 10939-40, 10953-61, 11093-97; *Time*, Aug. 2, 1954, pp. 8-9; *Newsweek*, Aug. 2, 1954, pp. 16-17; *New York Times*, July 24, 1954, p. 1.
53. *CR*, pp. 11020-90, 11358-77, 11389-90; *New York Times*, July 24, 1954, p. 1.
54. *CR*, pp. 11352-53; Wildavsky, *Dixon-Yates*, pp. 114-15; *New York Times*, July 25, 26, 1954, p. 1.
55. *CR*, pp. 11488-97, 11532-38, 11554-55, 11565-66, 11573-74, 11703-13, 11739-52, 11754; *New York Times*, July 27, 28, 1954, p. 1.
56. *CR*, pp. 11771, 11872; Conference Report (H.R. Report 2639, 83 Cong., 2 sess.), Aug. 6, 1954, printed in *CR*, pp. 13056-71.
57. *CR*, pp. 13071-78, 13638-64.
58. *CR*, pp. 13982-85, 14043-48. The second Conference Report (H.R. Report 2666) was printed in *CR*, pp. 13873-88. Atomic Energy Act of 1954, P.L. 703, 83 Cong., 68 Stat. 919.

CHAPTER SIX

1. *Newsweek*, March 30, 1953, p. 31. Other reporters noted the same attitude among the troops: Robert Bennyhoff in *Las Vegas Review-Journal*, March 17, 1953, and Robert E. Baskin in *Dallas News*, March 22, 1953.
2. For earlier continental tests, see Richard G. Hewlett and Francis Duncan, *Atomic Shield, 1947-1952*, Vol. II of *A History of the U.S. Atomic Energy Commission* (University Park: Pennsylvania State University Press, 1969), pp. 535, 563-64, 571 (hereafter cited *Atomic Shield*).
3. Fields, Special Atomic Detonations for Weapons Effects and Training, AEC 487/2, Nov. 6, 1951; CM 624, Nov. 7, 1951; Fields to Dean, Jan. 3, 1952, with attachments, all in AEC.
4. The best reports on the diagnostic tests are classified. See Operation *Upshot-Knothole*, Report of the Deputy Test Director, Los Alamos Report WT-816, pp. 13-19; Summary of *Upshot-Knothole* Tests, June 4, 1953, both in AEC.

5. Goodwin, Description of FCDA Technical Program, undated but probably March 16, 1953; FCDA, Proposal for Civil Effects Test and Demonstration Program, June 1952, both in AEC.
6. FCDA, *Operation Doorstep*, published booklet, 1953.
7. There is an extensive collection of press clippings on this subject in DDE. The following are a representative sample: *Life*, March 30, 1953, pp. 24-25; *U.S. News & World Report*, March 27, 1953, pp. 38-40; *Minneapolis Star*, March 23, 1953; *Providence Journal*, March 17, 1953; editorials in the *Philadelphia Inquirer*, March 22, 1953, and the *Washington Post*, March 18, 1953, p. 12. On television coverage, see *New York Times*, March 18, 1953, p. 45, and *Variety*, March 18, 1953. Val Peterson's statement was issued in an FCDA press release, March 18, 1953, AEC. Eisenhower's endorsement is in *New York Times*, March 19, 1953, p. 1, and *Public Papers of the Presidents of the United States, 1953: Dwight D. Eisenhower* (Washington: Government Printing Office, 1960), p. 113.
8. AEC-DOD Test Information Office, Las Vegas, Background Information on Continental Nuclear Tests: The Spring 1953 Series, undated, AEC.
9. AEC-DOD Test Information Office, Las Vegas, A Fact Sheet on Continental Nuclear Tests, Jan. 14, 1954, AEC.
10. AEC, *Thirteenth Semiannual Report* (Washington: Government Printing Office, 1953), pp. 77-125 (hereafter cited *Thirteenth Semiannual Report*).
11. Committee on Operational Future of NPG, Summary of Minutes, Jan. 14, 1953; R. E. Cole to Fields, May 8, 1953, with Report of Committee on Operational Future of NPG, both in AEC.
12. Estimated yields were noted in Proposed Program for Operation Upshot, AEC 487/28, Feb. 2, 1953, AEC.
13. Summary of Upshot-Knothole Tests, June 4, 1953, AEC.
14. AEC, *Fourteenth Semiannual Report* (Washington: Government Printing Office, 1953), p. 49 (hereafter cited *Fourteenth Semiannual Report*). For a concise history of the development of radiation protection standards, see Lauriston S. Taylor, *Radiation Protection Standards* (Cleveland: CRC Press, 1971).
15. The pretest precautions monitoring system is fully described in *Thirteenth Semiannual Report*, pp. 96-112.
16. Test Director to Division of Military Application, March 18, 26, April 20, 27, May 9, 1953. These appear in AEC 487/45, AEC 487/46, AEC 487/50, AEC 487/52, and AEC 487/54, respectively, all in AEC. Richard G. Hewlett, "Nuclear Weapon Testing and Studies Related to Health Effects: An Historical Summary," in Interagency Radiation Research Committee, *Consideration of Three Proposals to Conduct Research on Possible Health Effects of Radiation From Nuclear Weapon Testing in Arizona, Nevada, and Utah* (Washington: National Institutes of Health, 1980), pp. 51-54, 78.
17. Operation Upshot-Knothole, Report of Deputy Test Director, Los Alamos Report WT-816, pp. 72, 78, 96-98.
18. AEC-DOD Test Information Office, Las Vegas, Press Releases 70, 71, 72, all on May 19, 1953, all in AEC. Weiss described his experiences in St. George in Transcript of Meeting on Statistical Considerations on Field Studies on Thyroid Diseases in School Children in Utah-Arizona, Dec. 3, 1965, pp. 3-5, Document 9735, PHS Archives. For another eyewitness account of incidents at St. George, see Frank A. Butrico to William Johnson, n.d., in House Committee on Interstate and Foreign Commerce, Subcommittee on Oversight and Investigations, *Hearings on Low-Level Radiation Effects on Health*, April 23-Aug. 1, 1979, Serial 96-129 (Washington: Government Printing Office, 1979), pp. 781-84 (hereafter cited *Radiation Effects Hearings*).
19. Oliver Townsend to Trapnell, May 20, 1953; Dean Diary, May 21, 25, 1953; Senator Arthur V. Watkins to Dean, May 23, 1953, all in AEC; *Washington Post*, May 21, 1953; *Baltimore Sun*, May 21, 1953; *New York Times*, May 25, 1953. AEC files contain many letters of inquiry addressed to the President about weather effects—e.g., L. D. Faunce to Eisenhower, June 11, 1953; Ruth M. Smith to Eisenhower, June 12, 1953, both in AEC. AEC received about 1,000 letters on weather effects. See Public Relations of Continental Tests, Sept. 23, 1953, AEC. For published articles, see *U.S.*

News & World Report, May 29, 1953, pp. 43-44; *Newsweek*, May 25, 1953, p. 37; *Newsweek*, June 1, 1953, p. 23; *Newsweek*, June 22, 1953, pp. 28-29; *U. S. News & World Report*, June 26, 1953, pp. 50-66. AEC files also contain numerous Congressional inquiries. See Sterling Cole to Dean, June 10, 1953, and Dean to Cole, June 12, 1953, both in AEC 652/1, June 16, 1953, AEC.

20. CM 862, May 13, 1953, AEC. The local fallout figure was reported in *Fourteenth Semiannual Report*, p. 50. The potential integrated dose was the theoretical *maximum* exposure that an individual remaining in that area would have received in the first thirteen weeks following the fallout. The amount actually received would depend upon whether individuals followed precautions to avoid fallout. The rainout at Troy was reported on p. 52. See also Bugher to Fields, May 14, 1953, AEC.
21. Many documents in AEC related to the sheep losses have been published in *Radiation Effects Hearings*, pp. 679-91, 717-36, 752-75.
22. Director of Military Application, Proposed Additional Shot for *Upshot-Knothole* Series, AEC 487/55, May 13, 1953, and CM 863, May 18, 1953, both in AEC.
23. CM 864, May 20, 1953; Zuckert to Dean, May 20, 1953; Dean to Zuckert, May 27, 1953; CM 866, May 22, 1953; Dean Diary, May 25-26, 1953; Dean to Strauss, May 26, 1953; Dean to Lay, May 19, 1953; Lay to Dean, May 27, 1953; Dean to Cutler, June 1, 1953, all in AEC.
24. AEC-DOD Test Information Office, Las Vegas, Press Release 84, June 4, 1953; Meteorological Criteria for Test Detonations at Nevada Proving Grounds, AEC 652, June 4, 1953; Zuckert to the Commissioners and General Manager, June 9, 1953; Zuckert to Fields, June 18, 1953; Fields to Zuckert, June 23, 1953, all in AEC.
25. Tyler to W. L. Guthrie, July 22, 1953; Elliott to Committee Members, Aug. 10, 1953; Tyler to Committee Members, Sept. 14, 1953, all in AEC.
26. *Radiation Effects Hearings*, pp. 692-93, 698-705, 709-16, 737-51, 776-79; CM 888, July 15, 1953; Director of Biology and Medicine, Sheep Losses Adjacent to the Nevada Proving Grounds, AEC 604/3, Nov. 4, 1953; same title, AEC 604/4, Jan. 13, 1954, all in AEC; *Bulloch vs. United States*, 133 F. Supp. 885 (D. Utah 1955); *Bulloch vs. United States*, 145 F. Supp. 824 (D. Utah 1956); U.S. District Court for the District of Utah, Memorandum, Findings of Fact and Conclusions of Law, Aug. 4, 1982, DOE.
27. Tyler to Fields, Sept. 29, Dec. 21, 1953; Tyler to Committee Members, Oct. 19, 1953, all in AEC; Report of the Committee to Study Nevada Proving Grounds, Los Alamos Report SFO-LA-7 and 7A, Feb. 1, 1954, LASL.
28. Director of Military Application, Use of the Nevada Proving Grounds, AEC 141/22, Feb. 5, 1954; CM 962, Feb. 17, 1954; E. C. Stakman, chairman, ACBM, to Murray, March 25, 1954; GAC 39, March 31-April 2, 1954; I. I. Rabi, chairman, GAC, to Strauss, April 9, 1954; Director of Military Application, Use of the Nevada Proving Grounds, AEC 141/25, June 24, 1954; CM 1012, June 30, 1954, all in AEC.
29. Progress Report to the Joint Committee, Nov. 1953, in AEC 129/54, Dec. 1, 1953, AEC. On the 9,150-ton goal and its relationship to projected procurement, see Dean to Executive Secretary, National Security Council, June 10, 1952, in AEC 359/13, June 12, 1952; CM 723, July 16, 1952; and J. C. Johnson to M. W. Boyer, Nov. 7, 1952, in AEC 359/22, Dec. 3, 1952, all in AEC.
30. Director of Raw Materials, Uranium Ore Procurement, Draft Report to the NSC, Aug. 3, 1953, in AEC 359/27, AEC.
31. On developments before 1953, see *Atomic Shield*, pp. 426-27. See also Johnson's remarks to American Mining Congress, Sept. 23, 1954, AEC.
32. Press reports on the Colorado boom and to some extent on foreign sources began to appear in 1953. See articles: Burt Meyers, *Grand Junction Sentinel*, May 17, 18, 1953; Edward Hughes on South African developments, *Wall Street Journal*, June 1, 1953; John Worrall on South Africa, *New York Herald-Tribune*, Sept. 6, 1953; Herbert L. Matthews on Canadian boom, *New York Times*, July 24, 1953; on Wyoming ore discovery, *Washington Post*, Oct. 25, 1953. Charles Steen told his story in *American Weekly* in *Washington Times-Herald*, Sept. 27, 1953, pp. 4-5.

33. AEC Progress Reports to the Joint Committee, Nov. 1952, Nov. 1953; General Manager's Monthly Reports to the Commission, Raw Materials, Jan.-May 1954, all in AEC.
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CHAPTER NINE

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CHAPTER TEN

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